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SIGNAL

14th

ANNUAL

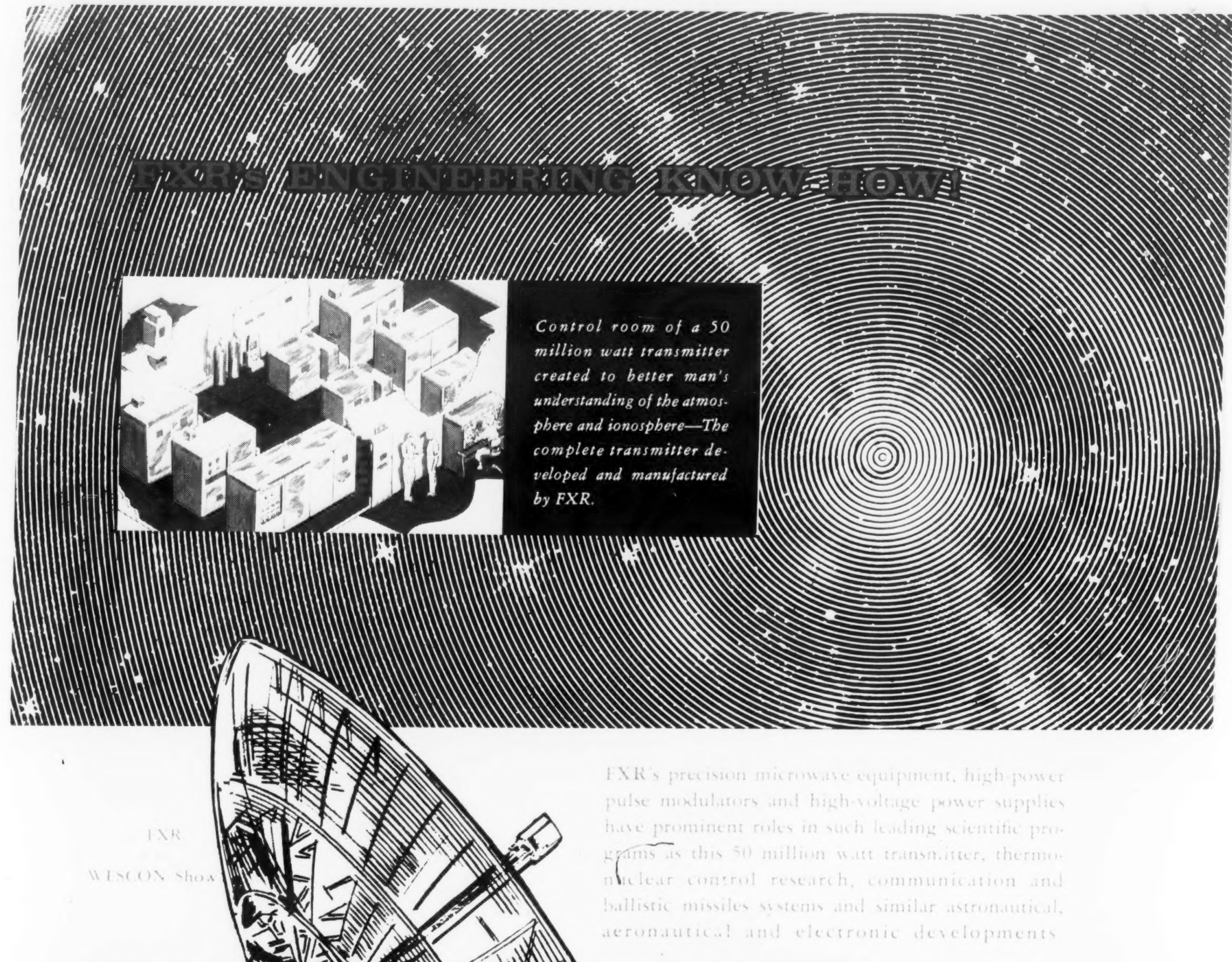
AFCEA

CONVENTION

REPORT ISSUE

JULY 1960

The Arm of Control — The Voice of Command



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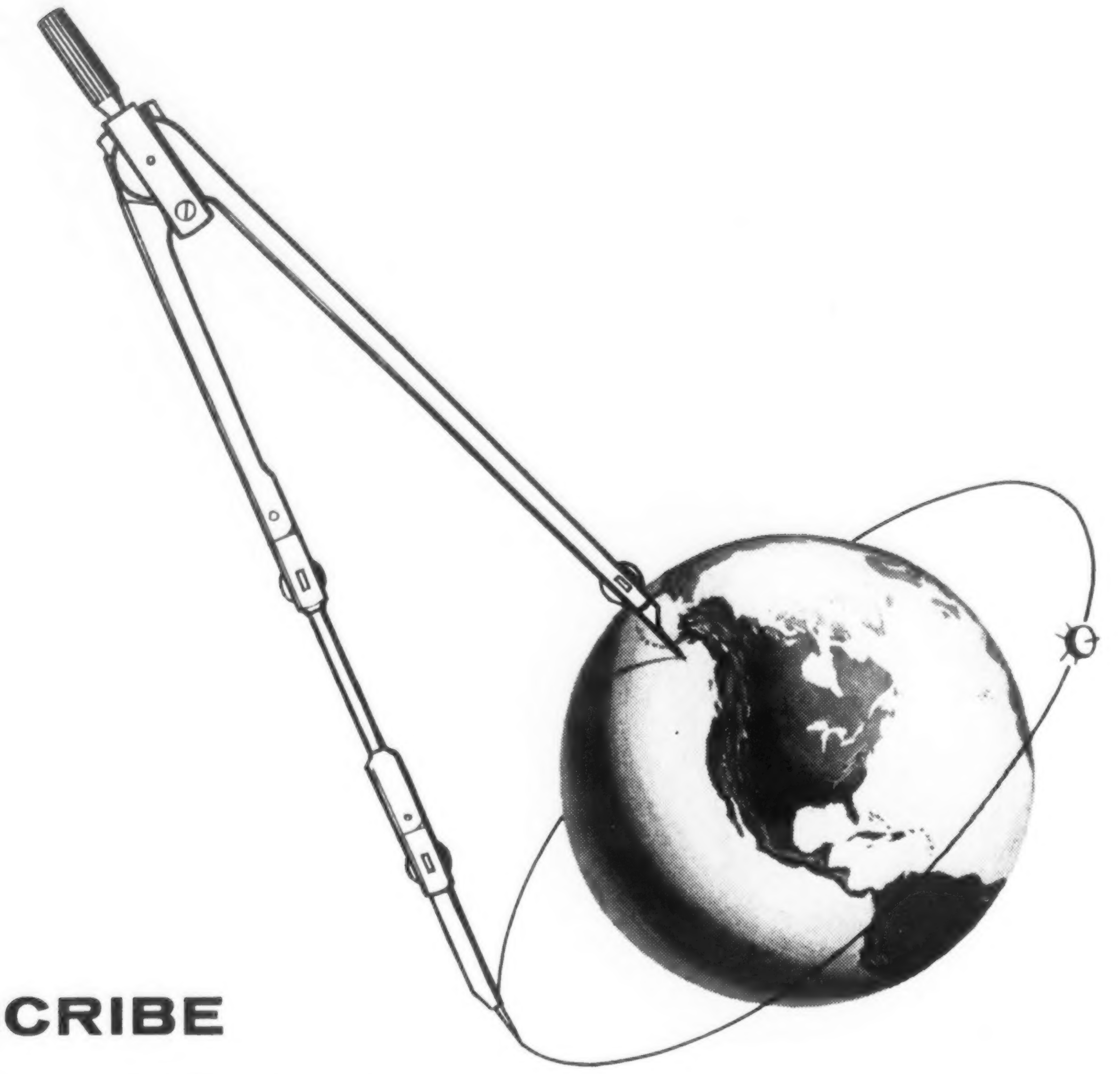

HOW TO SCRIBE A "PERFECT" CIRCLE IN OUTER SPACE

Bell Telephone Laboratories guidance system achieves unprecedented accuracy in steering Tiros weather satellite into orbit

Equipped with TV cameras, tape recorders, solar cells and antennas, the world's most advanced weather satellite, the NASA Tiros I, had to be placed in a precisely circular orbit at a specified altitude to do its job well.

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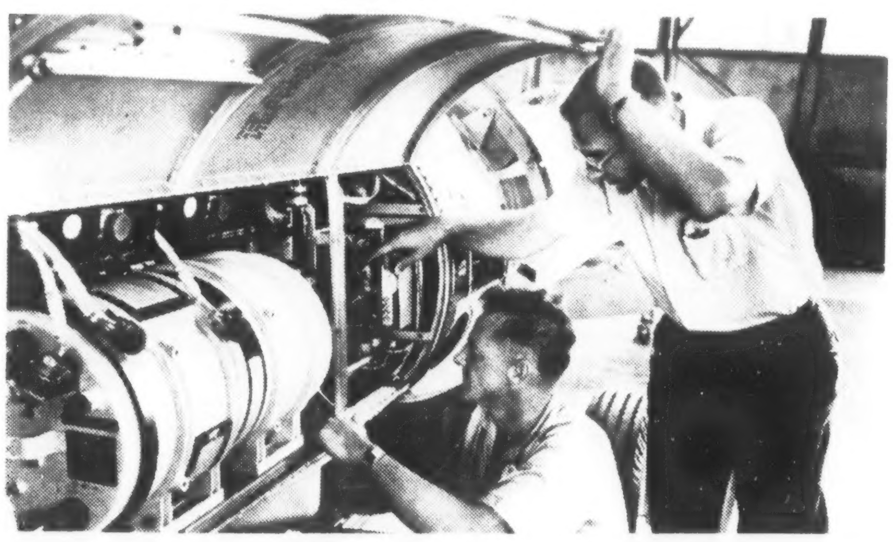
The dependability and accuracy of Bell Telephone Laboratories' ground-controlled Command Guidance System have been proved before—in the successful tests of the Air Force Titan intercontinental ballistic missile, and in last year's Air Force Thor-Able re-entry test shots from which the first nose-cone recoveries were made at ICBM distance. Now, with Tiros, the system contributes to a dramatic *non*-military project. Other uses are in the offing.

This achievement in precise guidance again illustrates the versatility of Bell Laboratories' research and development capabilities—directed primarily toward improving your Bell telephone service.

Two Bell Laboratories engineers, T. J. Grieser and D. R. Hagner, look over the second-stage section of the Air Force Thor-Able missile used to launch the NASA Tiros weather satellite.



BELL TELEPHONE SYSTEM

SIGNAL

Communications-Electronics-Photography

Journal of the Armed Forces Communications and Electronics Association

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DEPARTMENTS

B. H. Oliver, Jr.
National President, AFCEA
Vice President Upstate
New York Telephone Company

AFCEA Re-Elects President

A year ago the Armed Forces Communications and Electronics Association was pleased to introduce as its new president Mr. Benjamin H. Oliver (Signal, August 1959). After a year of great activity and progress, the entire membership of AFCEA unanimously sought his re-election as National President, at the annual meeting of the Association on the 24th of May 1960. It is with a feeling of deep pride that we make this announcement and extend to Mr. Oliver our sincere congratulations on his acceptance to serve for a second term.

Devoting hours of his energy, drive and enthusiasm, at extra curricular activities beyond his normal responsibilities as Vice President, Upstate, New York Telephone Company, Mr. Oliver has increased the growth and spirit of our Association. To say this is not to minimize the many outstanding contributions by our past national presidents but, more precisely, to emphasize that AFCEA is moving progressively forward under Mr. Oliver's executive leadership and direction. We have all come to appreciate "Ben" as a man of action and self sacrifice when there is a job to be done for AFCEA.

One has only to reflect upon the accomplishments of the past year to appreciate fully the wisdom of his policies and the soundness of his judgment in strengthening the aims and objectives of AFCEA. Our National Officers and Directors, our Chapter Presidents and the entire membership stand ready to assist our President in carrying out not only the programs which he has started but many projects which he has in mind, specifically designed to further strengthen our Association.

The Editor

Some of the Annual Banquet Guests

Some of the Annual Banquet Guests

1960 AFCEA NATIONAL CONVENTION HIGHLIGHTS

by W. J. Baird
Editor

ONCE AGAIN WE COME TO THAT very enjoyable occasion following a successful Convention which affords one an opportunity to express AFCEA's sincere thanks and appreciation for the many contributions made by all those who contributed their time and services on behalf of the Association. The entire membership of the Armed Forces Communications and Electronics Association is deeply indebted for the efficient manner in which every conceivable detail connected with all phases of the Convention program was handled and executed by the members of the following Committees: Panels; Tours and Transportation; Reception and Hospitality; Publicity and Public Relations; Buffet and Reception; Ladies Activities; Advisory Group; Tickets; and Accounting. And, in naming the above it would be remiss if we did not state emphatically that, without their outstanding cooperation and dependability, this year's show would not have earned the reputation of being the best in the history of AFCEA.

Strikingly enough, the 1960 14th Annual Convention and Exhibit, featuring the industry-military team concept theme, "The Arm of Control—The Voice of Command," was destined to be a success as far back as December 1959. For, it was on this date that our show manager, Mr. William C. Copp, began to receive the rewards of his early campaign efforts in booking exhibit space. Within a short period of approximately six weeks, 163 outstanding exhibits featuring modern and future communications and electronics equipment were guaranteed by 83 company exhibitors. Regrettably, during the four intervening months before the opening of the show, many of our friends and exhibitors had to be turned away due to the lack of exhibit space available at the Sheraton-Park Hotel. As the show got under way on 24 May, it soon became evident that many old convention records would tumble. For instance, the Association was pleased to register our largest attendance to date (approximately 4300); presented the most modern technical panels in the history of the Association, which drew a larger attendance at each session then the combined total of all attendees at any previous show; established a record smashing attendance for our social events, with John Gilbarte providing a glamorous entertainment and Buffet par excellence; and finally, displayed interesting military exhibits commemorating the 100th Anniversary of the U. S. Army Signal Corps. These sterling exhibits were made possible through the courtesy, support and cooperation of the Army, Navy, and Air Force Communicators.

SIGNAL Magazine is most appreciative for the press coverage which was received during the Convention. It is especially indebted to its own Editorial Staff not only for the excellent Pre-Convention publicity, but more importantly for the extra responsibilities assumed in running an efficient and well organized press relations room during the Convention. Mr. Raymond Schoonover of Mr. Copp's staff in New York not only rendered valuable assistance in all press room activities, but also arranged with Miss Judith Shreve (SIGNAL Managing Editor) for me to make a tape recording during the Convention on "The Importance of Communications and Electronics Today and Tomorrow," which was broadcast to millions of listeners over 470 Mutual Radio Stations.

The ever popular amateur ham radio hobby of many of our AFCEA members was once again much in evidence. This makes the third year that the Department of Navy has installed station K4NAA at the Sheraton-Park Hotel and we never cease to wonder at the enthusiasm shown by literally hundreds of visitors who assemble at this very popular activity. We are deeply indebted to the Navy and the personnel which operated this station.

At a time when we were wondering just exactly what should be done to present an outstanding program for the ladies attending the Convention, we were most fortunate in having the charming Mrs. Dorothy Christopher accept our invitation to handle the entire ladies activities. Mrs. Christopher, assisted by Mrs. Dorothea Ostenberg, organized the entire program which pleased all the ladies and was a credit to the Association. This is the second time in three years that Mrs. Christopher has come to the assistance of AFCEA and we want her to know that the entire membership is profoundly grateful.

From the opening phase of the Convention which featured the first public demonstration of communication by way of a moon bounce (Communication Moon Relay, CMR) to Hawaii and return to the Convention hall, coupled with the opening panel dealing with the electronics and communications necessary for putting a man into space, an air of excitement prevailed and lasted until the final curtain.

A special tribute is due especially to our National Officers and Directors, the Regional Vice Presidents, the Chapter Presidents and the Chapter Representatives of the Association who sacrificed time from their busy schedules to attend the Convention and meetings and remained to assist in every way possible for the success of this year's show.

SIGNAL Magazine wishes to express its sincere thanks and appreciation to our exhibitors and advertisers: Mr. John Ferguson III, Monumental Printing Company, Baltimore, Md.; Mr. Lynn Anderson, D. C. Engraving Company, Washington, D. C.; Mr. William Robinette, Art Consultant, Washington, D. C.; and to the members of National Headquarters for their support and interest in the 1960 Armed Forces Communications and Electronics Association Convention.

As reported by an authoritative and distinguished lady member of the press, Mrs. Gladys Montgomery, "The program was tops; you had an outstanding selection of speakers for the big events and this year's technical sessions were superb. I think that the Convention has never been as stimulating—then, too, the exhibits were especially good. There was a feeling of friendliness that pervaded the entire Convention."

Convention VIP's


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KEYNOTE LUNCHEON ADDRESS

by

ADMIRAL ARLEIGH BURKE, USN
Chief of Naval Operations

"The best equipment in the world is useless unless the services can get it in the quantities needed."

THERE ARE FEW things more enjoyable than a meeting with men of the Armed Services and men of industry, to discuss common problems, and exchange ideas on subjects of vital interest. That is why it is such a particular pleasure to speak to this Communications and Electronics organization.

This fine Association, of which I am proud to be a member, constitutes a real partnership, based on cooperation. Many of you are members of industry, and by industry I mean not only our giant corporations, but also most emphatically, the small businesses that infuse so much vitality and diversification into the electronics capacity of this country. Many of you are in the Armed Forces. This organization welds all of you into a team, working for a common goal, constant improvement in communications and electronics. Through this effort, you enhance the welfare and security of our great nation.

Your discussions during this convention and in future forums, can benefit the entire nation. Military developments in electronics frequently have commercial applications; and the reverse is equally true. Radar, the remarkable electronic development of World War II, guides our airliners. Sonar, that helped win the Battle of the Atlantic, now assists our fishing fleets.

Television, which we enjoy today, tomorrow may very well permit commanders to direct distant combat operations. The amazing growth of the electronics industry has already contributed much to the over-all economy and strength of the U. S.

Your efforts, which have done so much, are needed even more in the missile age. The very complexity of the new weapons necessitates your cooperative effort. What is on our drawing boards right now, may well decide the outcome of future battles. The Armed Forces need the creative thinking of all.

Your convention theme, "The Arm of Control—The Voice of Command," is particularly appropriate. All the services put this theme into application constantly. Communications supply our voice of command. Through the knowledge gained from a wide variety of electronic systems, we effectively control our forces.

The voice and the arm are mutually dependent. Intelligent, effective command must have the information obtained from the detection systems. In turn, the ability to receive and disseminate information quickly, to direct the weapons, makes the arm effective.

This is not a new concept. For centuries military forces have recognized the vital importance of communications. Naval communications are as old as naval warfare itself, essential to every naval operation. From earliest sea battles in the Mediterranean, to the swift, efficient landings in Lebanon, naval leaders have realized that adequate communications are necessary for effective command and control.

When England's great naval hero, Nelson, put a spyglass to his blind eye, to avoid breaking off action, he was dramatically demonstrating his awareness of the importance of communications. He was merely employing an early, self-imposed form of communication silence. His superiors may have called it an outage. But, whatever it was called, it was successful. He won the Battle of Copenhagen.

Your Navy has always looked for new methods of communications. We adopted the wireless, almost as soon as it was born, and took it to sea in its infancy. To sailors, radio has long been a formidable weapon, not merely a form of support. Radio is an integral part, a most vital part, of our naval strength.

For centuries, even into the early part of this century, fleets depended primarily on visual communications. In World War II, the ships in our task forces were concentrated for mutual support. Within these forces, messages were sent by visual, and relatively secure, means. Flag hoists, blinker, and short-range radio served us well.

Now however, new techniques and weapons have made mobility and dispersion both necessary and effective. They have also made it necessary to engage the enemy at far greater ranges. To achieve this we need communications and electronics of greater and greater capabilities.

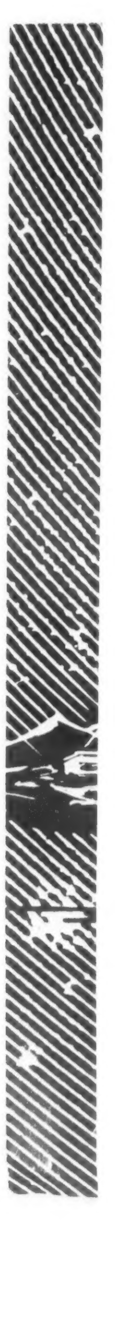
Today, our nation faces the exponents of a militant Communism. Recent Communist actions show clearly that there has never been any change in their avowed policy of world domination. To further their goal, the Communists employ any means; subversion, espionage, threats, insults, and outright aggression.

They make their own rules, and use a dictionary all their own in which peace means surrender, and freedom means slavery. They are flexible, very flexible. Meeting this threat requires our total defense to be at least equally flexible.

We must respond swiftly, and decisively, to the wide range of possible Communist actions. We must be prepared to fight at a time and place, and in a fashion, not of our choosing. Weapons and forces must meet any situation: an all-out thermonuclear exchange, limited war, or the need for a show of force.

Our forces are balanced to deter aggression. Our great strength in nuclear weapon delivery makes any attack upon the United States, a warrant for an aggressor's own destruction.

In limited wars, our rapid response, using deployed and mobile



forces, gives reason to pause to any nation contemplating lesser aggressions. Our Navy has been in the forefront meeting these situations.

Navies are blessed with inherent mobility. This allows our nation to exploit all the unique advantages of the sea: to deploy our forces, to meet and stop local conflicts around the world. At the same time however, the deployment, the very mobility and dispersal of our forces, introduces many challenging communications and electronics problems.

The magnitude of the seas poses one of these problems. Our fleets operate across seventy per cent of the earth's surface. Our Pacific units move on the alert, from the Aleutians to the Philippine Sea, from Midway to the Antarctic. In the North Atlantic alone, there are 12 million square miles of ocean, and this is but a drop, in a one hundred and forty million square mile bucket.

Our fleets must be able to operate any place there is sufficient water under the keel. Global operations are highly complex and fast-changing. They require coordination of all elements of naval strength into the powerful entity which brings us victory at sea.

Naval operations must also be coordinated with the operations of the other services. Teamwork and cooperation are vital. To do all this, calls for the finest in communications and electronics.

Electronics provides the nerve center of all our Armed Forces in fighting land battles, gaining control of the air, and carrying out complex ASW operations. Future developments must keep pace with progress in ships and aircraft, with the new weapons of our ground forces. They must be tailored to fit the specific needs of each Service. Each has its own problems.

The Navy has many problems, because of its vast operating area, and also because of the very nature of the sea, and the requirements of operations at sea.

Among its many roles, every commissioned ship is a mobile communications station. They must be linked to each other, and to the shore establishment. Naval forces operate under, on, and over, the surface of the sea. The pounding of the waves on a rolling, pitching ship, the salt air and spray, the shock of carrier landings and the hazards of submerged operations demand rugged equipment adapted to the sea environment.

Decades of varied professional naval experience, years of communicating with submarines under any conditions in the remote areas of the world have produced the positive, dependable communications demanded by the POLARIS weapon system. They had to be perfectly fitted to their surroundings, and to their job.

So too, land and air operations, from humid jungles to frozen wastelands, present specific requirements. As we move into space, there too, we find unique problems, unique demands on equipment.

Our space efforts typify the quest for new knowledge about natural phenomena—the exploration of the unknown, which is the foundation of engineering and technology. Our reservoir of knowledge always needs refilling. Basic research is the wellspring of future developments.

Basic research, however, takes time, money, and effort. It has to be stimulated and furnished a suitable environment. Ideas pay big dividends, but ideas cannot be ordered into being. Advanced weapons, guided and ballistic missiles, high capacity communications and radically improved radar all stem from research.

Each of our military arms has benefitted from it. And these benefits continue for a long time.

The research of Christian Doppler, one hundred years ago, has been useful to the Navy for years, and promises even further valuable use in our navigation satellites, such as TRANSIT. The Navy's moon-relay system, linking Washington and Hawaii, resulted from continuing research projects in radio communications. Past research in electronics and photography now make satellite surveillance possible.

Our basic research is extremely important, but it is only one side of the coin. In the long chain, from the laboratory scientist to the operating sonarman, radarman, or missileman, there must also be test and evaluation and engineering improvement programs. These too are vitally important, essential steps in bridging the gap between the developing agency and the operator.

To be most effective these tests have to be conducted early, during the developmental stage. The services have to act as hard-boiled consumers with lots of sales resistance. We should be tough to convince because, when you in industry do convince us, we can be sure the equipment meets requirements and is suitable for service.

In achieving true suitability, several general factors must be kept in mind. One is susceptibility to countermeasures. Any enemy will try to develop equipment to counter our own. Jamming is serious now, but it would be far worse in war. The growing use of electronics systems magnifies the problem, because much of the interference comes from our own systems. We have to recognize this as a fact of life and develop equipment less vulnerable to interference, equipment that can function effectively in a severe ECM environment.

There must also be continued emphasis on reliability, because electronic failures at a critical moment can affect the fate of nations. Modern weapons and technology have made the penalty for lack of reliability greater than ever.

You can still spot the enemy from the foretop, but when you do, it will probably be too late. You need warning nets that work, and work all the time. No longer can men direct all our weapons unassisted; missiles require electronic guidance. Human beings still make the decisions, but here too, they need help.

In the past the admiral on the quarterdeck, or the general on horseback, had a relatively easy job compared to the one that faces the commander of today. Speeds, weapons, the urgent need for rapid, accurate evaluation and response have imposed additional burdens.

Those in command need surveillance equipment to dispel the smoke of battle. They need data processing, display systems and digital computers. The modern military commander depends upon these systems. They have to be reliable and they have to be reliable for long periods under rugged conditions.

Reliability keeps armies on the march, keeps the planes over the target, and ships at sea, day in, day out. It is reliability that permits sustained action, that gives our forces the staying power so vital to victory in any kind of war.

Part and parcel of this is ease of maintenance. Ships, squadrons, and Army units have to maintain their own equipment. We have to rely on our own technicians. They do a magnificent job, but they do not have the technical background of the designer, and there are never enough technicians. To help the ones we have do their jobs, requires designing simplification *in*, and designing complexity *out*.

There are rewards for all from

(Continued on page 32)

BANQUET

An American Speaks

ADDRESS

by
LEO CHERNE
Executive Director
Research Institute of America

MY CONCERN WITH communications has been with the language of freedom and with the means by which we use that language to safeguard our liberty and assist those who are not equally privileged to enjoy theirs. I know only one form of effective communications—it was an effective communication during the ages before electronics and the effectiveness is multiplied many-fold through the incredible advances of science which give added speed and infinite distance to the words we use.

Effective communications involves simple principles. Communication—to move people, to motivate action, to achieve purpose—must be clear, consistent, courageous, and based upon a careful understanding of the purpose sought to be achieved by the communication.

In a sense, I am an odd guest on this occasion, because the invitation was extended to me with the knowledge, shared by several of your officers, that this dinner would take place during a week which was expected to be the week following a successful Summit Conference. That is what made the invitation to me, in at least one sense, inappropriate. I must honestly say that I have been no enthusiast of summit negotiations, of exchanges of heads of state, of concessions concerning Berlin or Central Europe, nor have I been intrigued with the promise of what has come to be known as "peaceful coexistence." I am far happier tonight to frankly discuss problems in communications we as a nation face and face now—I am far happier, not because I am pleased that the possibility of peace has receded—quite the contrary. My objection to the Soviet-defined characteristics of peaceful coexistence flows precisely from my conviction that they are incapable of producing, to use President Eisenhower's phrase, "peace with safety and justice."

Soviet Objectives

The communications with which I have been concerned involve the Soviet campaign for peaceful coexistence, which is essentially a campaign of psychological warfare directed against us and against the instruments essential to the survival of the non-Communist world. There is little debate that the following objectives advance Soviet strength and weaken ours: Division or destruction of the North Atlantic Treaty Organization (NATO), neutralization of Western Germany, division between Germany and the Atlantic states, unilateral disarmament in the West, a weakening of Western will in Berlin and Western acceptance of permanent Soviet sovereign control of the present captive European states. Now these have been the Soviet objectives. To the extent that beguiled, we as a people permitted ourselves to move toward them, these objectives have become Soviet achievements and Western defeats.

The partial, and I am certain, temporary, price we have paid in effort, in dignity, in direction, in moral conviction and in disappointment can prove slight indeed if we learn the lessons in communcation and in psychological warfare that are essential to the general search for peace with safety and justice. I advise, toward that end, the following proposition: The communications involved in the protection of freedom, in a free society, cannot be divorced from credible reality; the communications cannot be a posed, postured, tactical position of a government advanced cynically and without the indispensible substance of public understanding and acquiescence. The Soviet Union must also be concerned with popular opinion. It both significantly and cynically shapes that opinion and is frequently free to totally disregard it. We cannot disregard public opinion nor can any free society. Our great handicap and our great majesty reside in that fact.

As we examine the psychological implication of our national position —national strength—it is important to recognize that the word psychology itself has developed a distorted meaning. In a free society, psychology cannot but briefly be a garment obscuring contradictory behavior. It must, in fact, be exactly the opposite. Any weapon, to be effective, must be credible. This is a truism to hundreds of men devoted to military strength. If its purpose is effective, it must, in fact, be capable of destroying. If its purpose is deterrent, a word of awesome meaning to us because upon it hangs the possibility of sustaining peace, it will deter if there is a credible acceptance by the enemy that the weapon may be used. The weapon itself does not deter. A weapon combined with a resolute will does deter. A psychological weapon is the most vulnerable to incredibility. A Khrushchev ultimatum on Berlin sent the world scurrying because the possibility of Khrushchev signing a separate treaty with the Soviet puppet state in East Germany, and turning sovereign powers over to that puppet while maintaining Soviet armies on that territory and its handcuffs on that government, were painfully credible to us. That is what gave the ultimatum strength—the credibility of it to us.

A "sincere" tie and oxford grey suit will momentarily convey an impression of Madison Avenue, but in the world of international affairs the only sincere tie is one which truly binds. The words, the policy, the posture, can never be long separated from the action which tests them, demonstrates them, or disproves them. We have heard so much of the use of the word "peace" in these recent months of international intoxication. Peace alone can never be our purpose. A sentimental, unsophisticated search for peace leaves genuinely open and peaceful societies peculiarly vulnerable to public manipulation by pacifists, the weak willed, the frightened, the ignorant, the misinformed, the misguided, and even by those seeking consciously to destroy us.

Peace with Freedom

Peace for us, cherished as it is, must always emphasize the accom-

". . . communications involved in the protection of freedom, in a free society, cannot be divorced from credible reality. . . ."

panying requirements of freedom, safety and justice to ourselves and for all other people. Any other peace is cowardice. And, incidentally, any other peace has always been available. Peace by surrender is always in the anteroom of international conferences. So when we reach the conclusion that the Soviet Union does not seek war, as it undoubtedly does not, we must instantly add that it does, however, seek our defeat. This is so evident that it has been lost in our uncritical preoccupation with peace. Lenin said: "When the time comes to hang the capitalists they will rush to sell us the rope," and only time will demonstrate whether this cynical appraisal of our hungriness for peace will prove finally that we are that susceptible.

On a number of levels the Soviet Union is more vulnerable by far than we are. These are its major weaknesses: Its economy is less than half, though that half is more completely used to serve national purposes. Its people seek increasing satisfaction when Sputniks do not nearly satisfy the appetites of the hungry or six jammed into a room ten by twelve or of those denied freedom and justice. The Soviet Union is surrounded by a potentially hostile state—hostages in handcuffs tied to the Soviet Union. The Soviet Union is afraid of the contagion of freedom and cannot long expose itself to the virus without seriously weakening itself.

The Soviet Union painfully manifests its acute distress when its weaknesses are revealed or increased. How many Americans are aware that a Congressional resolution without teeth, without force, without purpose other than to express a majority will of both houses of Congress, calling a particular week "Captive Nations Week," brought forth a howl of despair and anger in the Soviet Union as though we had just unleashed the ultimate weapon on the Kremlin? In fact, I become depressed occasionally when I realize how unaware we are sometimes of how badly we hurt them. We therefore refrain from doing so with some greater frequency.

Psychological warfare, toward which the communications of national purpose are designed, consists of those incidents designed to increase the vulnerability of the enemy. They are effective in proportion to the consistency of their use and the credibility of the objective they are designed to achieve. The two essential attributes of Soviet psychological warfare against us have been (1) the orchestration of crisis for the purpose of dividing the free world; (2) the manipulation of the hope for peace for the purpose of disarming us. Those are the two consistent themes in Soviet psychological warfare.

The essentials in psychological warfare if our objectives are to be reached are (1) the demand for freedom for all those presently enslaved by force, by violation of treaty or by denial of law; (2) the aggressive search for reliable peace under a durable system of law susceptible of certain enforcement.

Our free society has an inherent disadvantage in psychological warfare. It must, as I have said, pursue the purposes it espouses. If its words are hollow the weapon backfires, producing disbelief abroad and disillusion among those here who hold the reins of consent. We cannot expext the psychological profit from a posture which seeks the liberation of the Central European states without a concrete program for the consequences of such a policy. Frankly it is inconceivable to me that we can conduct psychological warfare as we must against Soviet imperialism without a genuine policy of seeking self determination in the Soviet's hostage states by all means available—other than by direct military intervention—and those means are substantial indeed. We cannot long keep the Soviets from aggressively challenging the weaknesses of our position. We cannot, in any meaningful sense, negotiate with them from a position of strength, unless we persistently press upon the tenderest points in the fallible Soviet armor. If we are always to be the potential victim and the Soviet never, what alternative is there other than occasional erosion on the points of our strength. Psychological warfare for the United States requires us to throw our weight on the side of the free process. This is sometimes painful, as it was recently in Korea at such a painful cost to a heroic but misguided leader.

Psychological warfare requires that we accept the fullest consequences of our obligation to Berlin and demand freedom for those denied freedom in the other half of that city that seems somehow never mentioned—the other half of that city for which we also have legal responsibility. The Soviet Union uses the words of mockery to demand that West Berlin be made a free city. Can we not use, in fact, the words of truth to demand that all of Berlin for the first time be permitted to enjoy the right assured by four-power arrangement to be indeed a free city.

Our psychological warfare requires that if we are to be sensitive to the brutal consequences of Castro's Red-infested dictatorship in Cuba, we must have a companion concern for the

Banquet Address
(Continued from page 15)

absence of a free press, free votes, free labor movement, and the protection of law in Trujillo's baffled Dominican Republic.

We cannot always have it the comfortable way. Psychological warfare requires us to be faithful to yesterday's victims. If we acquiesce to sweeping Hungary or Tibet under anyone's rug, we must expect that that rug will be a red carpet for further Soviet advance. Psychological warfare—the art of communications designed to protect freedom—involves being constantly alert to the weaknesses of the enemy and attempting to increase them.

On the other hand, we must be alert to our weaknesses and protect ourselves against them. We cannot ask our people to bury their hostility for Mr. Khrushchev and be surprised that the major motion pictures rush to employ those who betrayed us yesterday and seek today to serve Soviet-sponsored purposes. Hitler and Munich and finally the explosion of World War II itself, were the products of psychological warfare manipulated by the totalitarian enemy but made so much more lethal by the psychological self-destruction of which some free people, adrift and misled, are unhappily capable.

Our weapon, our purpose, our will, our direction, our budget, the size and scope of our defense are the end product of the nation's psychology. National calls for sacrifice do not create the psychology of sacrifice if no sacrifice is, in fact, called for. This idea ought to be remembered by every single candidate for the Presidency. It has come to be standard procedure, running down to local offices, that it seems almost impossible to run for office without making a call for national sacrifice, and having done that, ask for none.

Similarly, overseas calls for freedom will not create freedom if no freedom is, in fact, intended to result or no program to achieve it stands behind the declaration. Psychological warfare without the belief that warfare exists, as in my strong opinion it indeed does, is ineffective.

If we are to enjoy our freedom and to preserve it, there can be no substitute for the most detailed knowledge of the enemy, his objectives, his methods, and resources. There can be no restful retreat from the pressures of protracted conflict, no illusory vacation in the miraged oasis of peace and brotherhood, except as these are the final consequences of the effort we initiate, painfully and consistently pursue, and achieve with certainty of enforcement as part of arrangements which require justice and rest on law.

Unhappily it has been my responsibility during these last 20 years, more often in government than in private, to convey unattractive reality. There is nothing about the dilemma we face which is novel. There is even less about it that is avoidable. I have taken the liberty of imposing stern words in an examination of the problem of communication we as a people face, at home and abroad. The Soviet danger, great as it is, must be measured, at least in part, by our inability to consistently see that it exists. If we do consistently recognize this danger, it will melt before the might of our purpose and the magnificance of American vision.

GLOBECOM IV

The fourth national symposium on Global Communications will be held at the Statler Hilton Hotel, Washington, D. C., during August 1, 2 and 3.

This year's symposium is co-sponsored by the Institute of Radio Engineers, Professional Group on Communications Systems and the U. S. Army Signal Corps. Emphasis will be placed on the consideration of the "long-lines" systems that cover substantial portions of the globe and large numbers of widely separated subscribers.

Through GLOBECOM IV, the co-sponsors hope to promote understanding of the problems involved and the new techniques necessary to meet the expanding needs and growing problems of concern to government and industry alike.

Guest speakers will be men who are nationally prominent in the communications field, representatives of both industry and government.

Co-chairmen of the Steering Committee for GLOBECOM IV are: Walter Larew, Brig. Gen., USA (Ret.), and James W. Jones, Lt. Cdr., USN (Ret.). Other members are Ralph L. Clark, Technical Program; John R. O'Brien, Arrangements; William H. Messenger, Public Relations; L. L. Nicholson, Cdr., USN (Ret.), Registration; John J. Renner, Finance; Benedict R. Jacobellis, Executive Secretary, and Thomas F. Horton, Chesapeake Instrument Corporation, Shady Side, Maryland.

For further information, call W. H. Messenger, OX 7-9408, Wash., D. C.

ADM. IRVIN NAMED COMMUNICATIONS AGENCY CHIEF

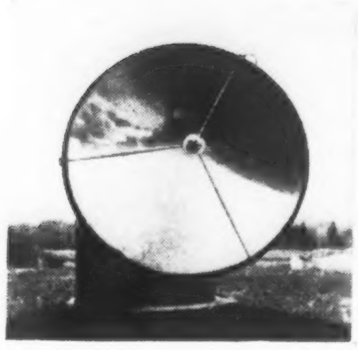
Rear Admiral William D. Irv[in], USN, has been appointed the fi[rst] Chief of the Defense Communicati[ons] Agency, (DCA) by Secretary of [De]fense Thomas F. Gates, Jr. Admi[ral] Irvin will be directly responsible [to] the Secretary of Defense through [the] Joint Chiefs of Staff for operatio[nal] control and supervision of comm[u]nications activities and facilities co[m]prising the newly established Defe[nse] Communications System, (DCS).

DCS, which centralizes the cont[rol] of all long-haul communications [re]quirements of the Department of [De]fense, will furnish facilities for co[m]mand and control functions, inte[lli]gence, weather, logistics and adm[in]istration. Communications requi[re]ments which have been met by t[he] military services in support of t[he] National Aeronautics and Space A[d]ministration also will be furnished [by] the new system.

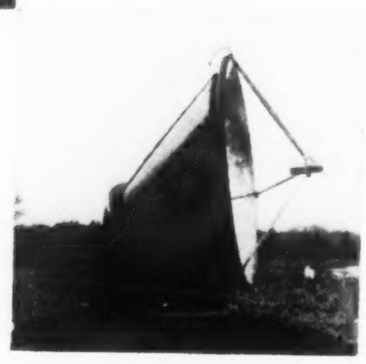
Specific responsibilities assigned [to] the DCA are the operational cont[rol] and supervision of the DCS whi[ch] includes all world-wide, long-ha[ul] government owned and leased, poi[nt]-to-point circuits, terminals, cont[rol] facilities and tributaries required [to] provide communications from: t[he] President to and between the Secr[e]tary of Defense, the Joint Chiefs a[nd] other government agencies; the Se[c]retary of Defense and the Joint Chie[fs] to and between the military depa[rt]ments and the unified specified co[m]mands; the military departments [to] and between their major comman[d]ers and subordinate fixed headqua[r]ters; and, the unified and specifi[ed] commands to and between their co[m]ponent and subordinate command[s].

Assumption of operational contr[ol] and full supervision of the system [by] the new agency is being accomplishe[d] on a phase basis in order to avoi[d] disruption of essential communic[a]tions during the transition perio[d]. This should be completed in approx[i]mately nine months.

Admiral Irvin is a graduate of t[he] U. S. Naval Academy, class of 192[.] He has served in various staff capac[i]ties, including Deputy Director f[or] Communications - Electronics, Joi[nt] Staff, Joint Chiefs of Staff and sin[ce] 1958 as Commander, Operation[al] Test and Evaluation Force, Atlan[tic] Fleet.

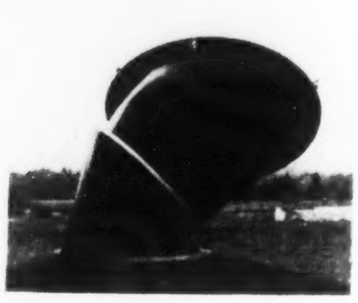


KENNEDY CYCLOCONIC MOUNTING



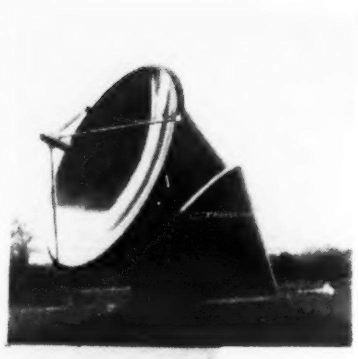
an advanced concept in antenna mounting

KENNEDY *Cycloconic* mounting has several significant advantages over conventional two-axis arrangements. With the *Cycloconic* method of mounting reflectors, two axes are provided, one vertical (azimuth) and one non-orthogonal (inclined) to the vertical. The reflector axis is at an angle to the inclined axis. By combination of rotations any direction of pointing may be achieved.



Cycloconic mounting eliminates the need for mechanical stops or limit switches. The large working diameters on *both* axes insure high angular accuracy. Continuous unidirectional motion about the azimuth and inclined axes provides meridian scanning with simple harmonic motion of the antenna beam.

The inclined axis of the *Cycloconic* mount provides a convenient "Vernier" for measurement of true elevation angle. For example, in satellite tracking low angle passes of short duration can yield quite precise elevation data.



The inherent stability and absence of mechanical limits of the *Cycloconic* mount result in a high survival capability under extreme environmental conditions. This extra ruggedness and rigidity make it ideal for mounting large antennas for radio telescopes. Dishes from 300 feet in diameter up may be *Cycloconic* mounted with total dependability. Loads on the antenna from dead weight, inertia and wind are handled with positive reliability.

KENNEDY *Cycloconic* mounts may be custom made to meet your specific requirements. They are the products of D. S. KENNEDY & CO., designers and builders of more tracking antennas, tropo-scatter systems and radio telescopes than anyone else in the field. The backlog of structural design and antenna technology gained through more than 15 years of activity in antenna installations has been applied to the design of this advanced mounting technique. You can consider *Cycloconic* mounting for your application with complete confidence. It will meet your highest performance standards.

Kennedy gives you experience you can't buy elsewhere.

D. S. KENNEDY & CO.

Antenna Division, Cohasset, Mass.
EVergreen 3-1200 Twx COH 311

Anchor Metals Division, Hurst, Texas
(Fort Worth) ATlas 4-2583

TRACKING ANTENNAS • RADIO TELESCOPES • RADAR ANTENNAS • SCATTER COMMUNICATIONS ANTENNAS • MICROWAVE RESEARCH AND DEVELOPMENT • TRANSMISSION TOWERS • SWITCHYARD STRUCTURE

Opening Ceremonies and Exhibits

Convention Events

ALDEN SCANNERS MARK NEW ERA IN FACSIMILE COMMUNICATIONS

Compact, mobile Alden Flat Copy Scanners are in use today throughout the U. S. Weather Bureau Hi-Altitude Facsimile Network — marking a bright new era of simplified, continuous facsimile communication. And here are the reasons why —

NEW INSTALLATION SIMPLICITY . . . within two hours of air delivery, Alden Scanners at the Hi-Altitude Network were uncrated from their fold-away shipping cases, rolled in, plugged in, and *fully tested* for 60, 90, and 120 RPM quiet and dependable operation.

NEW COPY HANDLING SIMPLICITY . . . map transmission is no longer dependent on exact drum mounting. With Alden's expandable copy feed head, maps of *any width or length* can be scanned, one after the other, fed straight or crooked, *with only one Alden Scanner.* Original plotted maps can now be scanned without cutting to size. Map plotters have originals returned in half the time. Space and maintenance problems are minimized.

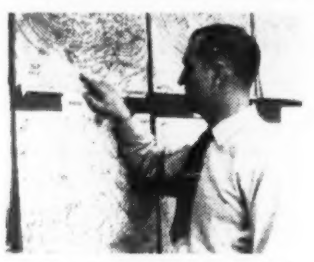
NEW CLARITY — NEW SHARPNESS . . . with copy feed rolls precisely positioning surface of the map on the flat copy scanner table, exact focal lengths are maintained for clear, sharp recordings. Focus smudge caused by unusually thick copy or copy lifting from drum is *completely eliminated.*

MEETS ALL FUTURE REQUIREMENTS . . . the practical scanning equipment for a world-wide facsimile map network. Speeds can be easily increased — without reengineering of equipment — for use with coaxial or microwave transmission facilities and computer-processed weather data.

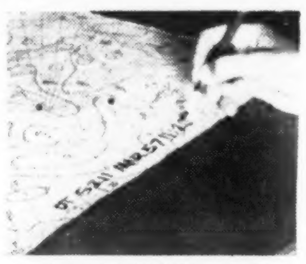
WHAT ARE YOUR FACSIMILE REQUIREMENTS? LET'S GET TOGETHER . . . Alden Flat Copy Scanners and Recorders are available in all sizes (and up to 30 times present network speed) to users and qualified manufacturers. Your inquiry is invited.

HERE'S WHY FORECASTERS PREFER* ALDEN RECORDERS AND ALFAX MAPS AND WHY WE THINK YOU'LL LIKE THEM TOO!

MOST COMMENDED FEATURES OF ALFAX MAPS



Color Is Easiest To Read Under All Lighting Conditions



Ease Of Writing And Erasing Enhances Analysis

Clean Crisp Duplicates By Bruning Or Ozalid

PLUS THESE UNIQUE FEATURES

LOW COST . . . Alfax papers save 1/3 to 2/3 yearly paper costs.

CLEAN . . . Electricity is the Ink . . . ion deposits make crisp brown marks on clean white background — free from dust, smudge and chemical irritants.

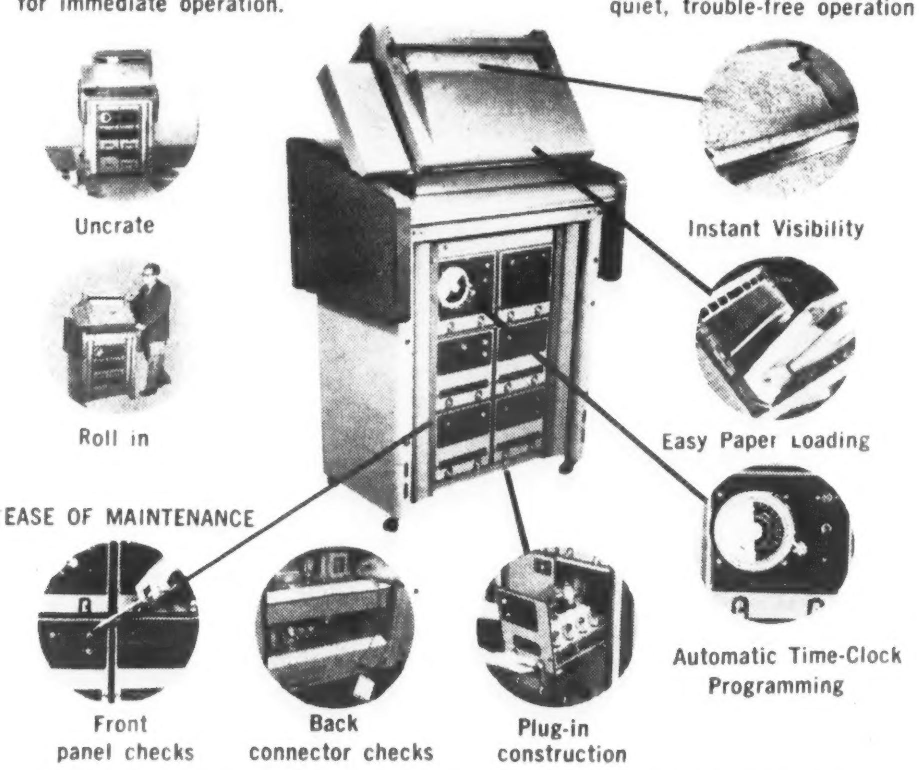
PERMANENCE . . . Alfax stores indefinitely . . . recording marks are permanent.

* In surveys of weather forecasters experienced with all weather facsimile systems, 3 out of 4 indicated a marked preference for Alden Recorders and Alfax Maps.

MOST COMMENDED FEATURES OF ALDEN RECORDERS

EASE OF INSTALLATION
Compact, mobile, and ready for immediate operation.

EASE OF OPERATION
A new high in clean, quiet, trouble-free operation



PLUS THESE UNIQUE FEATURES

SECURITY . . . Low voltage marking process does not generate a signal that can be intercepted.

HIGH SPEEDS . . . Sixty, 90 or 120 RPM operation — recorder technique and paper capable of 15 times these existing speeds.

VOLUME PRODUCTION . . . Designed for volume production on short lead time through unique expandable manufacturing processes.

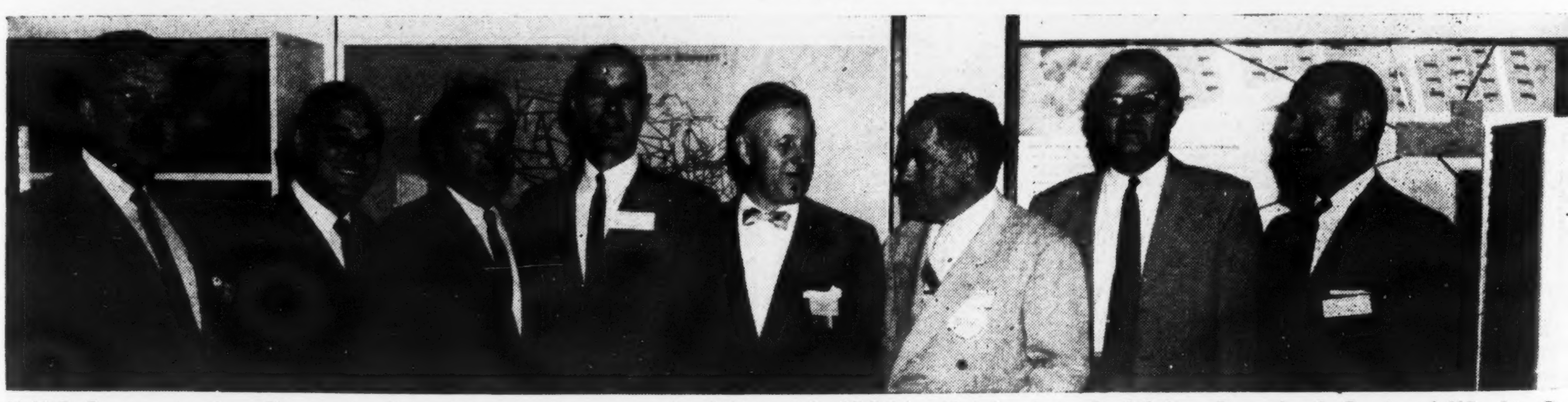
CEILOMETER BREAKTHROUGH

Used with rotating beam ceilometer, Alfax paper and Alden recording techniques replace continuous live scope observation with a continuous pictorial history of cloud conditions. Dynamic tone-shade gradients in warm color reveal all pertinent ceiling information in easy-to-read, easy-to-interpret form. Superimposed dark maximum signal marking shows exact reportable cloud height.

ALDEN ELECTRONIC AND IMPULSE RECORDING EQUIPMENT CO., INC.
Alden Research Center — **Westboro, Mass.**

(L to R:) B. H. Oliver, President of AFCEA, talks with the Assistant Secretary of the Navy for Material, Cecil P. Milne; the Assistant Secre- tary of the Air Force for Materiel, Philip B. Taylor, and Assistant Secretary of the Army for Logistics, Courtney Johnson.

3000th registrant, Edward Norman (L), CREI, is greeted by Joseph Heinrich, AFCEA Director; B. H. Oliver, AFCEA Pres., and W. J. Bair AFCEA Gen. Mgr. (R), Frank Martins, AFCEA Nat. Hqs., greets 4000th registrant Ens. P. K. Wormeli, USN.



NATO Communications-Electronics Committee members toured exhibits with AFCEA officials. L to R: Walter Pagenkopf, Regional VP; Lt. Co Fred Frank, USA, chapter pres.; Capt. G. T. Shirley, USN, U. S. member NATO committee; Cdr. N. M. Houot, FN, Deputy French member NAT committee; B. H. Oliver, AFCEA Pres.; Ray Meyers; Regional VP; Capt. Henry Williams, USN, Chairman NATO committee; George Ruehl, R gional VP.

Maj. Gen. R. T. Nelson, CSigO; Maj. Gen. Harry C. Ingles, former CSigO; Courtney Johnson, Deputy Asst. Sec. of Army for Logistics; Ma Gen. Spencer B. Akin, former CSigO, and Maj. Gen. George I. Back, former CSigO, before special Signal Corps exhibit.

INDUSTRIAL LUNCHEON ADDRESS

by

MAJOR GENERAL GEORGE I. BACK, USA (Ret.)
Assistant to the President
International Resistance Co.

"Prior to 1860, the still somewhat young American Army . . . depended largely on voice, whistle and bugle signals."

AT THE OUTSET LET ME SAY that I feel greatly privileged to be afforded the opportunity of participating in the commemoration of 100 years of the United States Army Signal Corps. It seems fitting that we should review briefly some of the events that led up to this 100th anniversary, some of the milestones that stand out prominently in the proud history of the Signal Corps.

In commemorating the Corps achievements, I want also to commemorate those contributions of our partners in industry and the contributions of our universities. The efforts of one—in ideas, research, design and fabrication—have complemented those of the other. In no other organization is this particularly productive relationship between the military and industry more evident than in the Armed Forces Communications and Electronics Association, which brings together not only mutual interests and the competence of industry and the Army Signal Corps, but *also* those of our sister services, namely the Navy and Air Force.

Most of us are aware of the fact that the American Indian had a system of communications that was quite effective. He conveyed messages through smoke signals, circling his pony, and mounting and dismounting. Prior to 1860, the still somewhat young American Army, without a formal, full-time signaling organization, depended largely on voice, whistle, and bugle signals. Some seventy-five different bugle calls communicated orders and instructions—those on the up-note meant movements to the right, those on the down-note, to the left, and so forth. I suspect this should make some of us who grumbled about learning the international code, pause for a moment and reflect on the fact that the *really old* Army had its problems, too. Incidently, history tells us that the bugler usually rode a gray horse to distinguish him in combat. Thus, also, he provided a good target for the enemy.

At this point in time enters a 29-year-old Army surgeon, a young man with amazing vision and ingenuity,—a man of stubborn beliefs and natural inventiveness—Major Albert J. Myer. His work with the deaf and their sign language, plus his interest in watching the Indians communicate, led to his concept of a signaling system for the Army. As the first Chief Signal Officer, he devised a flag and torch code which was used during the Civil War. His Signalmen — from man made signal towers and natural vantage points, introduced what might be called the first formal signaling system in the American Army,—signaling via Wig Wag.

Major Myer and his growing Corps moved on. He wanted to extend the *range* of communications. He wanted to increase freedom of movement of communications in the field—to let communications facilities follow the emphasis of battle, rather than to have the emphasis of battle hampered because of lack of mobility of communications. Working with civilian telegraphers in an early Signal Corps-industry framework, he introduced the Army's first electrical communications device, the Beardsley magneto-electric telegraph set. Hand-operated and portable, it was capable of signaling over several miles of insulated field wire. Known as the "Flying Telegraph," its characteristics of that day—although crude by modern standards—are significantly related to today's military concepts for field communications equipment,—concepts which stress light weight, mobility, and minimum size.

It might be worthwhile to note that a fixed, telegraph network, having longer range capabilities, brought the Army Signal Corps the national weather service assignment in 1870. These seeds of longer haul circuits were later to germinate and produce the strategic communications the Army has today, namely the world-wide fixed communication network.

Shortly afterward, the Corps introduced the heliograph and the telephone. The heliograph was originally tested at nearby Fort Myer—then called Fort Whipple; and the telephone, Bell's invention, was put to military use at the same location scarcely two years after Bell's initial success. The application of these new means to Army needs, and the civilian telegraphers who initially operated the longer distance telegraph systems, were forerunners of the effective military-civilian effort the Corps has brought to such a significant level today.

By integrating the heliograph into military communications, the Signal Corps gave the Army a better signaling system than the flag, particularly in difficult terrain. One could read the heliograph signals over far greater distances. The telephone brought a unique advantage. For the first time a commander could talk directly to his subordinates some distances away. The device gave him nearly the same personal influence as actually *being* there. I suspect a number of the tougher old Infantry and Artillery commanders greeted the telephone with considerable delight. Something of the proper flavor and emotion in a good "chewing out" suffers in translation from a heliograph or telegraph message.

In the second conflict to involve these early Signalmen—the Spanish-American War—telephone as well as telegraph communication was provided on the combat front in Cuba and at Manila Bay.

True combat communications were being born. The telephone enhanced the commander's personal influence and in many cases, direct control in combat; the telegraph moved messages under more and more difficult conditions at higher and higher rates of speed. Figuratively, the

Signal Towers were rising to greater heights.

Yet Signalmen who had inherited Myer's drive and imagination sought newer, more versatile and flexible communications. The first military radio communication was introduced in the Army in 1898. The commander's communications were no longer limited to those situations where a wire could be laid. With radio, he regained the tactical mobility of the heliograph and flag—and simultaneously retained the longer distance communication previously available only through wire circuits.

The growing communications capabilities of this relatively new branch of the Army led logically to another American major pioneering effort. The Signal Corps was given responsibility for communications to and within Alaska. Radio was put to immediate use in the system. One of the first military circuits was a 100-mile link across Norton Sound to Nome, Alaska, thus avoiding a difficult land line or underwater cable task. But cable was far from being neglected; with the advent of the gold rush in Alaska, the Corps laid a 2000 mile submarine cable to provide telegraph communications between Seattle and Alaska. To this day, the Corps is providing long haul communications for the civilian and military populations — both within the new State and between the State and Seattle.

Curiously enough, the advent of radio in the Army preceded by a few years the Signal Corps' introduction of the first military airplane—the Wright machine. Although actual operating aircraft radio sets were to come later, the effective control and employment of military airplanes over any distance depended vitally on the development of airborne radio equipment. Just at the turn of the century, before the Wright airplane was flown in Army tests, a great component advance had been made. Later the Signal Corps introduced the first military vacuum tube into the Army. With vacuum tubes and the potential they offered for amplification and new circuits, radio became an almost infinite source of communications possibilities.

As time progressed, aircraft radio sets were developed and installed in Signal Corps airplanes. Long-range ground radio circuits complemented improved wire and cable systems. The commander's communications means were expanding almost precipitously.

When the United States entered World War I, Signal Corps Field Signal Battalions consisting of radio and wire, and outpost companies provided telephone, telegraph, and radio service down to the barbed wire. As the war progressed, dramatic communications advances were introduced. Major Edwin H. Armstrong—a Signal Corps Officer in France, developed the superheterodyne circuit.—a major advance in the radio art. Many years later, he invented frequency modulated radio — opening the way for manifold improvements in short range tactical radio communications. —not to mention the applications of FM in the commercial communications field today. FM made possible the development of the Walkie-Talkie, and push-button command radios for tanks and other combat vehicles. Thus Armstrong's invention revolutionized mobile communications in combat and minimized the problem of interference.

Radar — although described as a detection or surveillance device—also communicates intelligence through its transmission of pulses and reception of data on scopes. Through the dedicated efforts of Colonel William R. Blair, the Army Signal Corps began developing radar as early as the thirties. Following successful developmental tests, production was expedited.—one of the early models was on site at Pearl Harbor to report the vital information that was not acted upon. Yet radar, with the tremendous new capabilities it gave the military, created the demand for more rapid and sophisticated communications capable of being integrated to serve the needs of detection, fire coordination, tracking and other rapidly developing requirements. These requirements were met.

Role of Radio Relay

Near the beginning of World War II, the Signal Corps placed in operation the first single sideband radio-teletype circuit. Further, the integration of carrier telephony and telegraphy with radio relay was conceived and radio relay teams with the necessary equipment quickly formed and shipped to overseas theaters. I need not remind this audience of the tremendously important role of radio relay as World War II progressed and the vital part it played in insuring uninterrupted communications in the dash of American forces across France and Germany and during our island hopping operations in the Pacific.

Yet the remarkable new vistas of strategic and tactical communications in which the Signal Corps was pioneering did not end with the Allied victory. A wholly new dimension was opened in 1946 by an Army Sig[nal] Corps radar at Fort Monmouth. T[he] first contact with the moon was ma[de] through signals reflected back to t[he] huge DIANA radar of the Army Sig[nal] Research and Development Labo[ra]tory. This startling achieveme[nt] proved the feasibility of space co[m]munications and marked the begi[n]ning of man's effort in this new e[n]vironment.

Concurrently, the Signal Corps e[x]panded its world-wide communicati[on] system, served by leased wire circui[ts] within the U. S. and radio and cab[le] circuits for traffic outside the U. [S.] Radio relay techniques were vast[ly] improved. The sudden emergency [in] Korea found Signal Corps radio rel[ay] teams in Japan called upon to su[p]port the new conflict. The Mobi[le] radio-teletype set proved to be th[e] work horse for communication b[e]tween higher headquarters in Kor[ea] and between Tokyo and Corps Hea[d]quarters at Inchon.

The first data processing faciliti[es] —a new addition to our communica[]tion system — were added to th[e] Army's global system in 1955. Use[d] primarily for improving the spee[d] and efficiency of logistic operation[s] its capabilities were expanded to mee[t] administrative requirements as wel[l]. Data transceivers have greatly ac[]celerated the flow of military suppli[es] from depots and ports to oversea[s] theaters.

Continuing to seek greater capa[]bilities from the radio relay concep[t] they had introduced, members of th[e] Army Signal Corps and industry de[]veloped the early ionospheric an[d] tropospheric scatter radio equipmen[t] and established the first circuits usin[g] this new technique. Conventional ra[]dio relay stations were improved an[d] mounted in shelters which could b[e] air-lifted by helicopters or carried o[n] a standard Army cargo truck.

Missiles dictated even greater im[]provements in communications an[d] control systems. Weapons systems us[]ing computer language required sup[]porting automatic data communica[]tions systems in the field. The Signa[l] Corps had foreseen this tactical re[]quirement and added this means t[o] its global system.

The Fieldata concept, in whic[h] data processing is applied to func[]tions of a field army, had bee[n] formed. Development of militariz[ed] computer and data processing equi[p]ment was undertaken with industr[y]. The first of these new equipments MOBIDIC, a large-scale mobile com[]puter—was delivered to the Sign[al] Laboratory early this year for eval[uation].

(*Continued on page 32*)

"HIGH POWER IN SMALL PACKAGES"

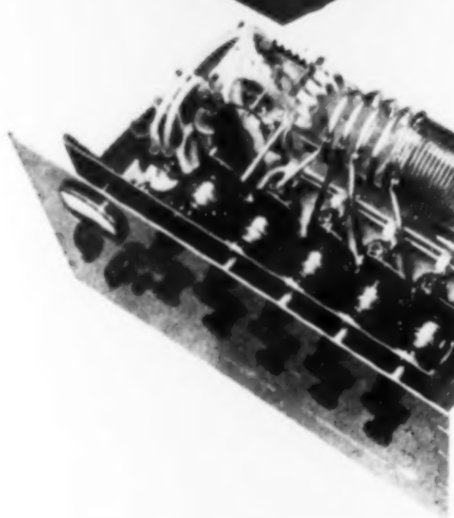
LINEAR AMPLIFIERS

from YUBA-DALMOTOR

NEW

In constant search for more favorable size and weight ratios, the imaginative engineering at Yuba-Dalmotor has developed two new compact linear amplifiers.

NEW



MODEL DM 4000
Complete and Instantaneous Band Switching

For the first time complete and instantaneous band switching with either local or remote control, from 2 to 30 MC, 2 to 5 bands. Unit is capable of 3000 watts PEP input on SSB, also suitable for AM, CW, FM and FSK. Highly efficient and compact through use of Jennings vacuum components, and 3 water-cooled Eimac high power tetrodes in a grounded grid configuration. High degree of linearity attained through use of screen clamping. Adaptable for amateur or commercial service – for portable, fixed station, or portable-mobile use. Available in cabinet or rack mounting.

NEW

MODEL DM 1000
Specifically for mobile SSB Operation

A completely new design concept in mobile communications—developed for SSB operation. Designed for bumper mounting, this unit puts the RF power directly into a conventional whip antenna. High power Eimac tetrode is used in highly efficient circuit, cooled by small amount of recirculating water. Rated at 1000 watts PEP input with minimum grid drive. Easily interchangeable plug-in units give multi-band operation.

Two new portable packages to power communications equipment now available from Yuba-Dalmotor: (a) A complete, field power unit with 3-phase, 400 cycle alternator, coupled gasoline engine, coolant and heat exchange components, (b) DC to DC inverter – to provide one KW continuous output from either 12 volt (DMP 1012) or 24 volt (DMP 1024) input.

YUBA

specialists in electronic and electromechanical equipment

YUBA-DALMOTOR DIVISION

1375 El Camino Real, Santa Clara, California

YUBA CONSOLIDATED INDUSTRIES, INC.

LADIES' ACTIVITIES REPORT

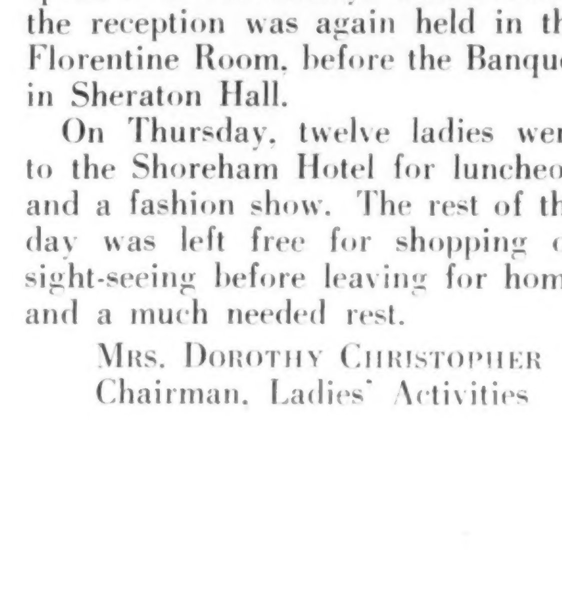
Tuesday morning, May 24, forty-three out-of-town ladies, attending the 14th Annual AFCEA Convention, met in the Madison Room of the Sheraton-Park Hotel for a "get acquainted coffee hour." Many of them took part in the activities planned for them during the Convention.

Tuesday afternoon we toured the Indian Embassy and the Wax Works Museum. In the evening the Convention reception was held in the Florentine Room of the Sheraton-Park Hotel, followed by the Buffet Supper in Sheraton Hall.

Wednesday morning we took a tour of the Pan-American Union and sat in on a consulate meeting for South America. That afternoon, luncheon was held in a private dining room at the Pentagon. After lunch Lieutenant Colonel Frances Elderdice, Plans and Policy Officer, Office Director, Women's Air Corps, spoke to us informally. That evening the reception was again held in the Florentine Room, before the Banquet in Sheraton Hall.

On Thursday, twelve ladies went to the Shoreham Hotel for luncheon and a fashion show. The rest of the day was left free for shopping or sight-seeing before leaving for home and a much needed rest.

Mrs. Dorothy Christopher
Chairman, Ladies' Activities



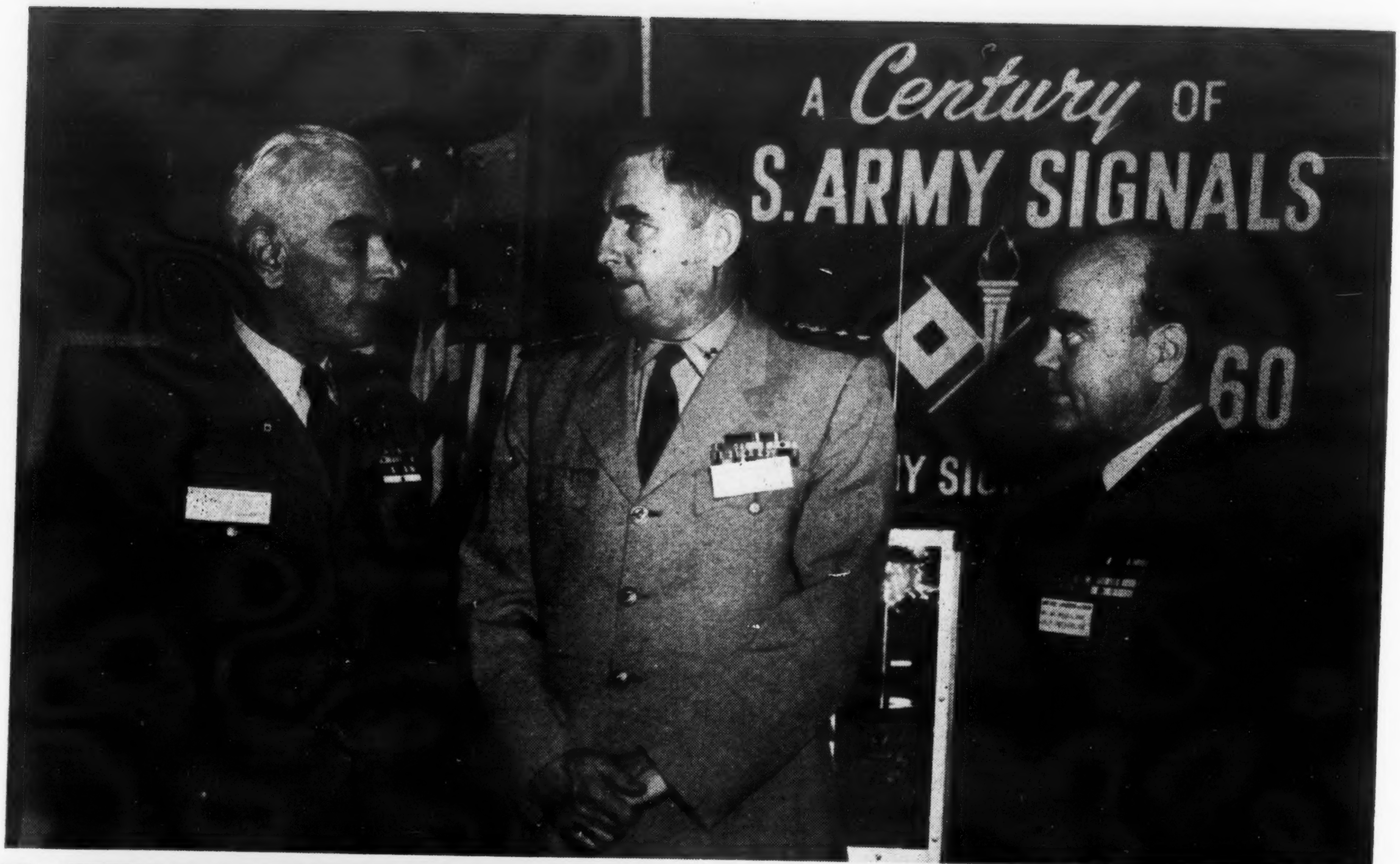
K4NAA CONVENTION HAM RADIO STATION

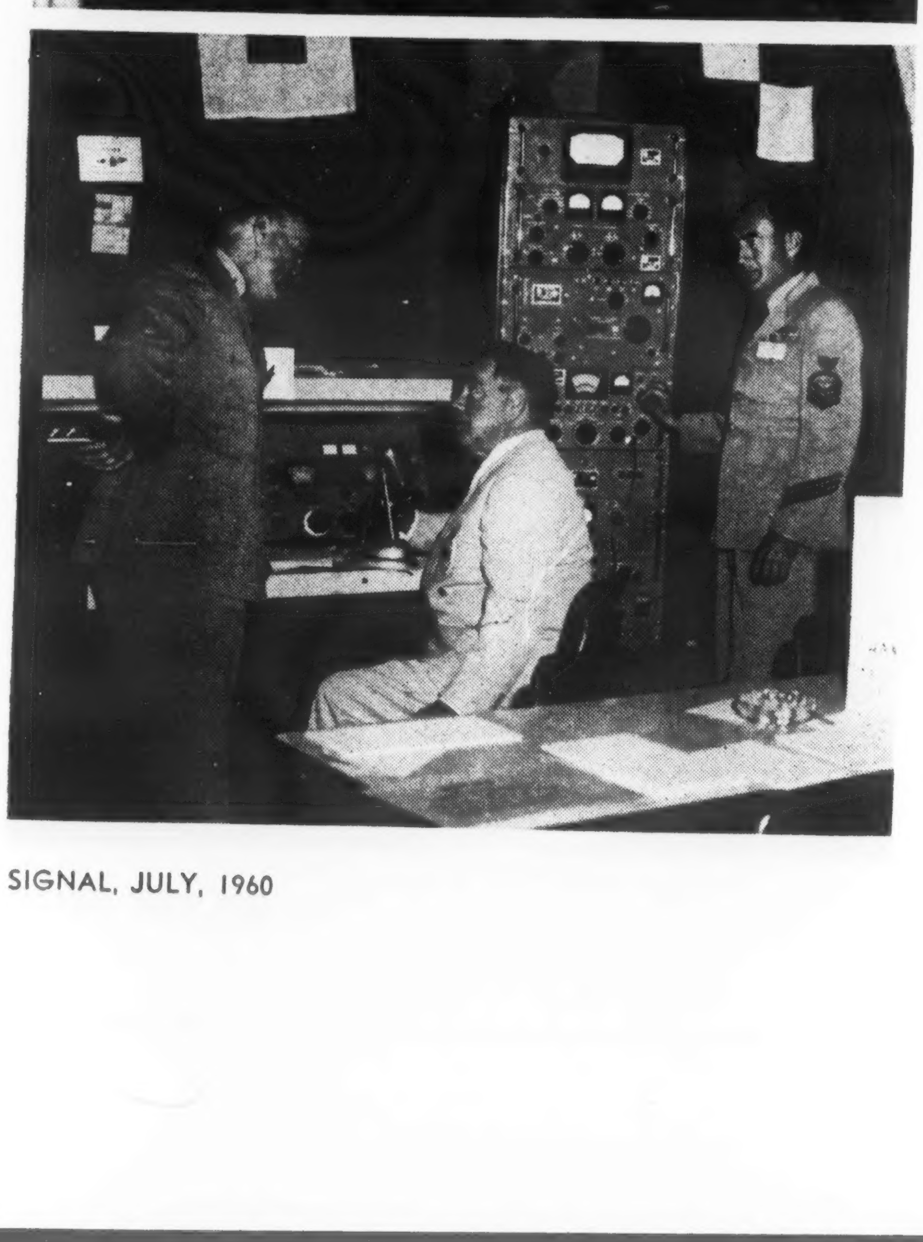
As in other years, the Nav
Communications' Amateur rad
station, K4NAA, received a war
reception from civilians and milita
at the 14th annual national conve
tion of AFCEA. Attendance at t
Navy's transplanted ham station w
up approximately 50% from la
year. All continental areas of t
United States were worked, includi
Canada, Newfoundland and Labr
dor, Jamaica, Puerto Rico and USC
Westwind (WAGB-281) were al
worked by those among the Navy
1,176 visitors.

Guest operators of K4NAA inclu
ed the Assistant Secretary of t
Navy for Material, the Hon. Cecil
Milne; Assistant Secretary of the A
Force for Materiel, the Hon. Philip
Taylor; Rear Admiral Frank Virde
USN, Director, Naval Communica
tions; Rear Admiral H. C. Bruto
USN, W4IH/F7A, Admiral Virden
predecessor as Naval Communica
tions Director; Major General Jame
Dreyfus, USA, Director, J-6; Maj
General R. T. Nelson, USA, Chi
Signal Officer; Major General H.
Grant, USAF, W4NAA, Directo
Communications-Electronics; Maj
General G. I. Back, USA (Ret.
former Chief Signal Officer, and, t
National President and General Ma
ager of AFCEA, Benjamin H. Olive
Jr., and Colonel W. J. Baird, US
(Ret.), respectively.

K4NAA's operating personnel wer
Henry C. Davis, RMC, W5OFH
F. A. Jewett, RMC, W1NCE; an
G. L. McCarney, YN2, K3DFU. Th
officer in charge was Commande
A. B. Kunz, USN.

Equipment used by K4NAA, su
cessor to the historic "Radio Arling
ton," was a TMC SBT-1K transmitte
and a TMC GPR-90 console receive
The SBT-1K is capable of SSB, A
and CW emissions with peak powe
on SSB of 1 KW. A tri-beam antenn
with rotor was installed on the roo
of the hotel. 10, 15 and 20-mete
bands were worked, with best result
obtained on the 20-meter band.





(top) The three Service Communicators, Maj. Gen. R. T. Nelson, USA, Chief Signal Officer; RAdm. Frank Virden, USN, Assistant Chief of Naval Operations (Communications)/Director, Naval Communications, and Maj. Gen. Harold W. Grant, USAF, Director, Communications-Electronics, are pictured in front of the U. S. Army Signal Corps exhibit as they toured the special service exhibits which honored 100 years of U. S. Army Signal Corps communications. Along with the Signal Corps display, many viewed the special Navy (middle left) and Air Force (middle right) exhibits. (bottom left) Capt. H. E. Thomas, USN, and Chief Francis A. Jewett, USN, watch as Ray E. Meyers, AFCEA Regional Vice President, operates ham radio station K4NAA.

PANEL DISCUSSIONS

NASA Panel: (left to right) John R. O'Brien, Herbert Rosen, Victor W. Hammond, Robert Briskman, Leonard Jaffe, Dr. Robert Coates, Dr. Nicholas Renzetti.

Bell Panel: (left to right) Millard C. Richmond, Dr. J. Pierce, L. C. Tillotson, W. J. Jakes.

Photography Panel: (left to right) RAdm. Dwight M. Agnew, USN (Ret.), H. Schoene, H. Meier, RAdm. Robert S. Quackenbush, USN (Ret.), Dr. W. Widger, Dudley Cline, S. Sherr. Not pictured, Dr. Morris Tepper.

GE Panel: (left to right) Thomas Jacocks, Richard Shetl Dr. William Glenn, Albert F. Wild, Lloyd C. Harriott.

Two of the four panel discussions presented at this year's Convention are published here. The August issue will contain the panel on Scientific Applications of Photography and the General Electric Industry Reports. Contained in this issue are:

Panel I

Communications and Electronics for Putting a Man into Space, National Aeronautics and Space Administration

MODERATOR—HERBERT ROSEN, NASA, INTRODUCED BY JOHN R. O'BRIEN, HOFFMAN ELECTRONICS

1. World-wide Tracking and Data Acquisition—Maj. Victor W. Hammond, USAF, Office of Space Flight Programs, NASA
2. Communications at Lunar Planetary Distance—Robert Briskman, Office of Space Flight Programs, NASA
3. Tracking Satellites—Dr. Robert J. Coates, Space Aeronautical Scientist, Tracking Systems Division, Goddard Space Flight Center
4. Advanced Technology for Space Communications—Dr. Nicholas Renzetti, Chief, Communications Engineering and Operating Section, Telecommunications Division, APO, Jet Propulsion Labs
5. Utilization of Satellite Communications—Leonard Jaffe, Chief, Communications Satellites, NASA

Panel II

Space Communications, Bell Telephone Laboratories, Inc.

MODERATOR—DR. JOHN R. PIERCE, BELL LABS., INTRODUCED BY MILLARD C. RICHMOND, WESTERN ELECTRIC

1. Problems of Satellite Communications—Dr. J. R. Pierce, BTL
2. Bell Laboratories' Part in the Echo Experiment—W. J. Jakes, BTL
3. Active Satellite Repeaters—L. C. Tillotson, BTL

Panel Transcription: Dictaphone Corp.

Panel I

Communications and Electronics for Putting a Man into Space

BY NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WORLD-WIDE TRACKING AND DATA ACQUISITION

SPEAKER: Major Victor W. Hammond, USAF, Office of Space Flight Programs, NASA

THE MISSION of Project Mercury is to initially explore man's capability in space missions and to provide the early steps in the development of space flight technology. To accomplish this, a rather complex network of ground support instruments is necessary. This has been planned and is currently being implemented. My purpose is to describe briefly some of the broad criteria that went into its planning, describe the network that will evolve and discuss our program to date.

There are four basic functions that any instrumentation network, be it a guided missile range, satellite ground instrumentation net or the Mercury net, must perform:

a. We must know the position in space of the capsule with respect to time and to a suitable geodetic reference. This establishment of the location of the capsule is the function of tracking.

b. Next we must know what is going on aboard the capsule. The data from the on-board instruments as well as that regarding the functioning of the astronaut must be returned to ground stations. This is the function of telemetering and communications to and from the astronaut.

c. Thirdly, knowing where the capsule is and what is going on aboard, we must be able to give instructions to the functioning elements of the capsule such as commanding initiation of recovery-retrograde rockets. This is the function of Command Control.

d. Finally, we must integrate the above three functions into an operable network. This brings in the function of ground communications and data links, the associated computation machinery and a point of Central Control of the entire net from launch to recovery.

With these general remarks let us now look at some of the planning criteria.

Network Planning Criteria

You must appreciate that the choice of launch azimuth, orbit inclination and other orbit characteristics, number of orbits, etc., that constitute the flight profile was a rather complex trade between available booster characteristics, necessary capsule weight, launch safety considerations, suitable recovery areas and available land masses for locating instrument stations. Further, the number of tracking, telemetry, capsule communication and command stations located along the earth's surface at the sub-satellite positions represents a further trade of meeting operational and scientific requirements with an attainable network from an economic point of view.

Rather than attempt to go through all of the details of the final selections, let me mention only several.

Take the launch azimuth and orbit inclination for example. The Mercury capsule will be placed in its 32.5° inclined orbit by launching North-East from Cape Canaveral at an angle of approximately 72°. Some of the reasons for this choice include the performance gains associated with the earth's rotation, it allows the capsule to return over the United States at the end of each of the 3 orbits, landings can be made in the highly instrumented Atlantic Missile Range at the end of the 3rd orbit and it makes excellent use of existing instrumentation facilities in Hawaii, Southern United States and Australia. Furthermore, it affords the use of Bermuda and the Canary Islands for support of the critical orbit insertion and emergency abort phases of the early portion of the mission. Lastly, the Southern Pacific Coast (Point Arguello/Pacific Missile Range) is in position to monitor and control the retrofire operation which initiates the re-entry maneuver.

After such considerations a final flight profile which actually represents requirements for the ground support net could be stated. In general, the design criteria for the net is to support a mission to be launched from Cape Canaveral Northeast. The orbit will be nearly circular. Because of capsule weight and booster capability, its altitude will be approximately 120 miles. Again because of the relatively low altitude and recovery considerations the mission will consist of three orbits with provisions to recover at the end of orbit one or two in the case conditions dictate early recovery to be desirable. Continuous tracking, telemetry and capsule communications should be maintained from launch through insertion and approximately 15 minutes following insertion. Continuous contact should also be provided through each re-entry maneuver including those at the termination of the first and second orbit. Over the remainder of the ground track, the stations should be placed so that no unplanned re-entry could occur without the knowledge of one of the ground stations. Many other practical criteria must be built in such as economic, logistic and operational considerations, availability of communications, site availability in the case of foreign sites and others.

Resulting Network

Having outlined the general problems of planning the network, let me next describe the resulting network as it is currently being implemented.

The net to support the orbital missions will consist of equipment at some 20 locations including 2 ships, the Control Center at Cape Canaveral and the Computing and Communications Center at Goddard Space Flight Center located at Beltsville, Maryland. Located throughout the world, the stations are at: Cape Canaveral: Grand Bahama; Grand Turk; Bermuda; Mid Atlantic Ship; Grand Canary Island; Kano, Nigeria; Zanzibar; Indian Ocean Ship; West Australia, Woomera, Australia; Canton Island; Hawaii; Southern California; West Mexico; White Sands; South Texas; Eglin Air Force Base.

The station distribution allows the continuous contact necessary during launch to injection and also during re-entry maneuvers on any of the 3 orbits. An exception to the coverage required to guard against unplanned re-entry has been made during the 3rd orbit. This relaxation was felt justified on the premise that if the mission has progressed successfully into the 3rd orbit, it is very likely to continue through to the planned re-entry pattern.

Not all stations are alike in terms of capability. To take the function of tracking first, you will find that we are using both S and C band radars. The use of both was desirable for redundancy and also from the necessity to use as much existing equipment as possible. Bermuda and Australia are two main locations that have both C & S band equipment. Australia is of course the antipodal location from Bermuda so by making both C & S band measurements from both of these locations the resulting description of the orbit can be given ve accurately, or in other words tw separate methods of orbit determin tion. Of course individual C & S bar tracking radar sites exist elsewhe in the net and also contribute to th over-all accuracy of rapid near-re time derivation of the position of th capsule, particularly during launc or re-entry operations.

Telemetering data is taken at mo of the stations using standard FM FM equipment in the 200 MC T band. Moreover, most stations a equipped to communicate with th astronaut. Two of the stations in th U.S., White Sands and Eglin, are n equipped with these capabilities onl because adequate coverage is othe wise available. The result is that th stations will be in contact with th astronaut for approximately 5 mi utes out of every 15.

Command control equipment pr viding the capability of direct r trofire or setting the retrofire tim is available at those stations whe such capability is required.

All stations will be connected by ground communication network to communication center at Goddar Space Flight Center at Beltsville. I general, leased facilities will be use Although in most cases voice com munication will be available, the pr mary dependancy for data transmi sion will be on the more reliable tele type system. The computation equi ment, also at Goddard, will be use to determine the orbit and provid acquisition data or "look angles" t all stations.

The hub of operational activitie involved with Mercury orbital flight will be the Control Center at Cap Canaveral. The staff here will tak over responsibility for the flight im mediately after lift-off. Some primar functions of the Control Center ar monitoring the flight includin launch, orbit and re-entry; monito astronaut and capsule status; initiat abort decision; command re-entr and, of course, control and coordina tion of the ground support instru mentation net and the supply o proper data to the recovery forces.

Progress

Our progress in implementing thi network can best be described b simply saying that we are on sched ule. We are aiming for completio of the network in sufficient time t allow thorough system exercising an operating personnel training befor any of the orbital missions. Our cur rent target date is therefore earl next year.

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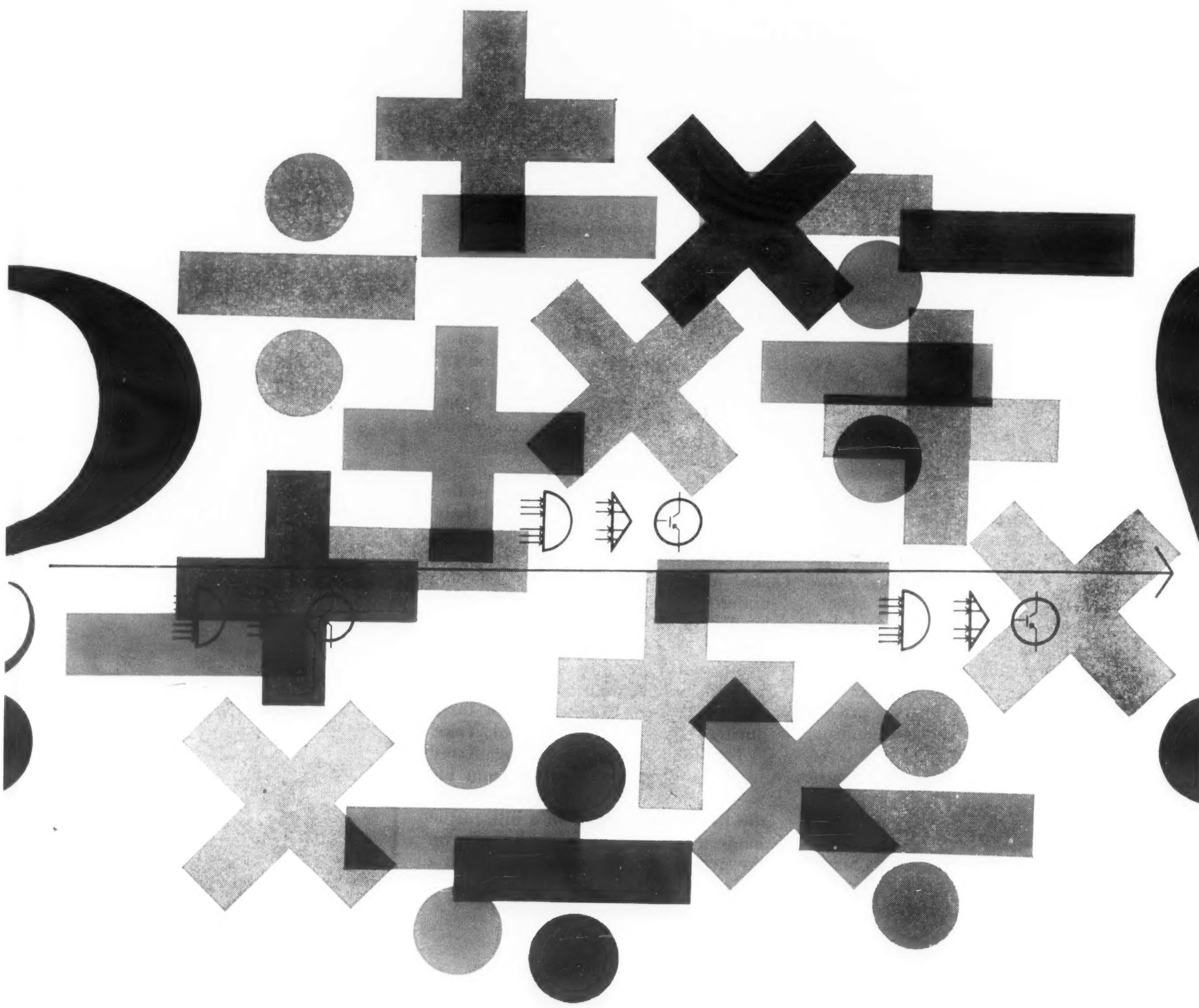


Keynote Luncheon Address

(Continued from page 12)

simpler equipment. First, it is easier to support; it requires less logistics and fewer parts. In any future conflict it will be up to the Navy not just to carry out its own important offensive operations. It must also furnish protection to the shipping that carries the supplies so vital to land and air power. The Army and the Air Force are big consumers, very big, and their needs will tax Navy forces to the utmost. That is why everything possible must be done to minimize the load.

In addition, simpler equipment is cheaper. Cost is a big problem to industry. It is just as big to the military. The best equipment in the world is useless unless the services can get it in the quantities needed. We have to be careful to avoid pricing our military readiness out of the market.

All of us must be alert in fighting this silent enemy, high cost, which robs us of our defense dollars. We must guard against unnecessary use of expensive materials and against costly modifications which fail to produce significant improvements.

Unwarranted criticism and campaigns against the limited military frequencies of the radio spectrum are a good example of non-productive expense. Should the Armed Forces be forced to shift to new frequencies and to change equipment to do so, the result would be harmful; not just in waste of the taxpayer's money, but also in prolonged reduced readiness. The money could be employed elsewhere in the advancement of electronics and be reflected in a stronger national defense.

Solving all these problems calls for scientific vigilance and teamwork. Improvements come more often from a systematic application of many steps, large and small, rather than from spectacular breakthroughs. This is the way you get the answers.

The members of this fine Association obviously realize this, because you have come up with solutions to difficult problems many times before and I am confident you will do so many times in the future. All of you have used well the great opportunity to contribute much to the security of our wonderful nation. You have helped guarantee that our communications and electronics, our Arm of Control and our Voice of Command, remain the finest in the world. My best wishes go with you in your efforts.

Industrial Luncheon Address

(Continued from page 24)

ation testing.

For air defense systems of the Army, where voice-telling by telephone and radio had once satisfied the then existing needs, a new requirement arose, that is, a communications system capable of automatic handling of computer language. As one answer to this requirement MISSILE MASTER, the air defense coordination and control system for NIKE and HAWK missile batteries in the United States; and MISSILE MONITOR, the mobile tactical electronic system for a field army were developed.

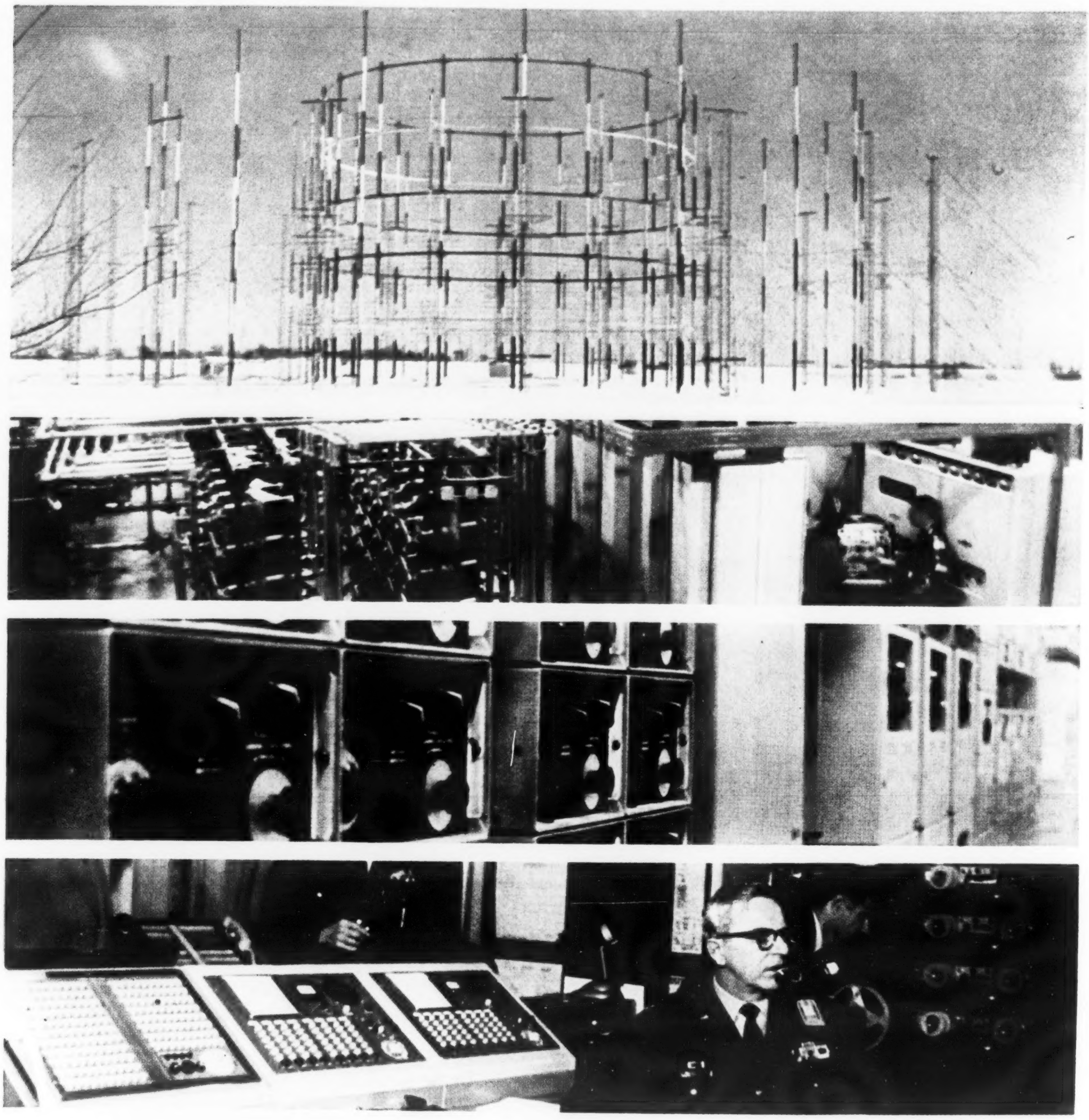
Turning to the environment of space, the Corps together with industry, developed the world's first communication satellite—Project SCORE, which actively relayed the first human voice from outer space. This spectacular demonstration, conducted under the direction of the Advanced Research Projects Agency, proved conclusively that voice and multiple teletypewriter signals could be relayed directly or by delayed repeater transmissions from a satellite in space. The ultimate use of satellite communication stations as corollaries to ground stations was assured. Signal Towers are approaching infinity in height.

And today — with mobile radio switching centrals, push-button telephones, and four-wire electronic communications systems; and with longer range projects such as the Universal Integrated Communications System, or UNICOM, a concept for an integrated global communications system that will provide high-speed automatic switching and transmission of video, facsimile, voice, and record communication signals — the Army Signal Corps continues to pioneer in the science and art of communications.

Truly, these men and women of the U. S. Army Signal Corps and their predecessors have made significant and enduring contributions which began with the first Signalmen who, under General Myer, sped messages by flag and torch.

It is then on behalf of all their fellow colleagues in the many fields of military and civilian communications and electronics that we salute them during this—their Centennial Year.

The trail from the young Army surgeon who was inspired from his work with the deaf, and learned from the Indians signaling on a hill, to the modern communication techniques on the ground and in space, has been a dedicated and most distinguished one.



Panel Discussions
(Continued from page 30)

COMMUNICATIONS AT LUNAR PLANETARY DISTANCE

SPEAKER:
Robert Briskman, Office of Space Flight Programs, NASA

MAJOR HAMMOND HAS OUTLINED some of the space communication problems of Project Mercury, a manned satellite vehicle which is relatively close to the earth. One of the NASA program objectives is to achieve manned spaceflight to the moon, and I am going to discuss space communication as it applies to manned vehicles at lunar and interplanetary distances. Actually, most of the following comments on deep space communication apply equally well to manned or unmanned vehicles, with the manned vehicles having a greater emphasis only on reliability.

Since deep space communication has a large number of important variables, the best initial starting point is with the basic objective of the system. Simply, this is to pass information. However the transmittal of large amounts of information over enormous distances is an extremely difficult problem with today's state of space communication technology.

To illustrate this point, Pioneer V space probe will be used as an example. Right this second (May 21) Pioneer V is slightly over 11 million miles from the earth. For those in the audience not familiar with the Pioneer V communication system, I would like to briefly outline the important characteristics. The space probe was developed and constructed by the Space Technology Laboratories. The probe transmits data in digital form at any of three rates (64, 8 or 1 bit per second) selected by ground command. The digital data can be transmitted by phase modulating either a 5 watt or a 150 watt transmitter, again selected by ground command. The transmitters operate at 378 MCS and drive linearly polarized dipole antennas. However, transmissions are also limited by the power supply, heat dissipation and similar factors to around two hours per day at 5 watts and one-quarter of an hour per day at 150 watts.

Apparently the power supply system has deteriorated and since May 18, it has been impossible to turn on the 150 watt transmitter by ground command. The five watt transmitter is still continuing to operate with a reduction in length of transmission. For the remainder of the probe's useful flight, the primary data acquisition station will be Jodrell Bank in Manchester, England. The Jodrell Bank station is utilized under a NASA contract with the University of Manchester. I would like to note that the Director of Jodrell Bank, Dr. A. C. B. Lovell, and his staff have displayed the utmost cooperation on all NASA spaceflight operations. For Pioneer V, the Jodrell Bank station utilizes the 250 foot steerable parabolic antenna, a parametric pre-amplifier, a phase coherent receiving system having a —160 dbm per cps threshold, and a 10 KW command transmitter.

To illustrate an important point in space communications, Figure 1 shows the amount of information per day that Pioneer V has transmitted and would have transmitted if the 150 watt transmitter remained operational. The information transfer has occurred with a space communication system that has been transmitting thirty times the power ever used on any United States space probe, is using extremely sensitive receiving equipment and is using the largest antenna in the Free World. Even with these achievements, relatively small amounts of information can be transmitted. It is important to note that the amount of information transmitted by Pioneer V is sufficient to relay all the data from its instrumentation and to satisfy all the technical objectives of the flight. Even so, the total information passed is fairly low.

Before expressing Figure 1 in comparative form, a bit (abbreviation for binary digit) is defined as a choice between two equiprobable events, i.e., a bit is the most elementary form of information. For the English language, there are approximately 22 bits in an "average" word for short messages. This indicates that a man in Pioneer V today could send about a 220 word voice transmission to Jodrell Bank. In July the daily data rate will drop further to 605 bits per day. Now the space voyager is limited to a 28 word message a day. This may not be too bad, especially if a non-loquacious astronaut is chosen. However the transmission of high quality photographs poses a staggering problem, since each photograph requires at least a million bits to be passed.

There are many advances in the art of deep space communication NASA is pursuing to increase amount of information that ca transmitted at long distances. Du the time limit, the description of t will be necessarily brief.

a. *Vehicle Transmitters.* This b force method of increasing space c munication capacity will be us only when much larger pay weights are available. High po transmitters cause problems in dissipation, power supply drain, term reliability, on-off operation. However it would appear that po transmitters in the range of on ten kilowatts will be used in this cade.

b. *Vehicle Antennas.* Pionee is wastefully radiating its power over the universe. A significant in better space communications be to place an antenna on the veh to concentrate all the radiated po towards the earth. Such an atte will be made next year by the NAS Jet Propulsion Laboratory, which responsible for the deep space gram. Essentially a small parab antenna will be placed on an attit stabilized space probe vehicle will increase its communication ra by a factor greater than seven. major restraint on the vehicle ante size is presently the accuracy of vehicle attitude stabilization syste

c. *Vehicle Power Supplies.* NA has vigorous programs in nucl radiant, thermo-electric, solar ionic power supplies (SUNFLOW SNAP). It is anticipated that a quate power will be available on vanced vehicles such as Saturn.

d. *Ground Stations.* Presently N SA is installing a three station work for deep space communicati which will be equipped with 85 f antennas. It is called the Deep Sp Instrumentation Facility (DSIF) a is under the technical direction of Jet Propulsion Laboratory (JP In fact, Dr. Renzetti of this panel the person in charge of this progr at JPL. The three stations are s arated approximately 120 degr in longitude so that any space pr can at all times be under the surv lance of at least one of the grou stations. For a heliocentric pro trajectory, the rotation of the ea is the only appreciable change in apparent probe position once vehicle is distant from the ear

Of the three DSIF stations the o in Goldstone, California is curren operational. The station consists two 85 foot antennas, a polar mount one for receiving and a azimuth-e vation one for transmitting. A rece ing site should be operational

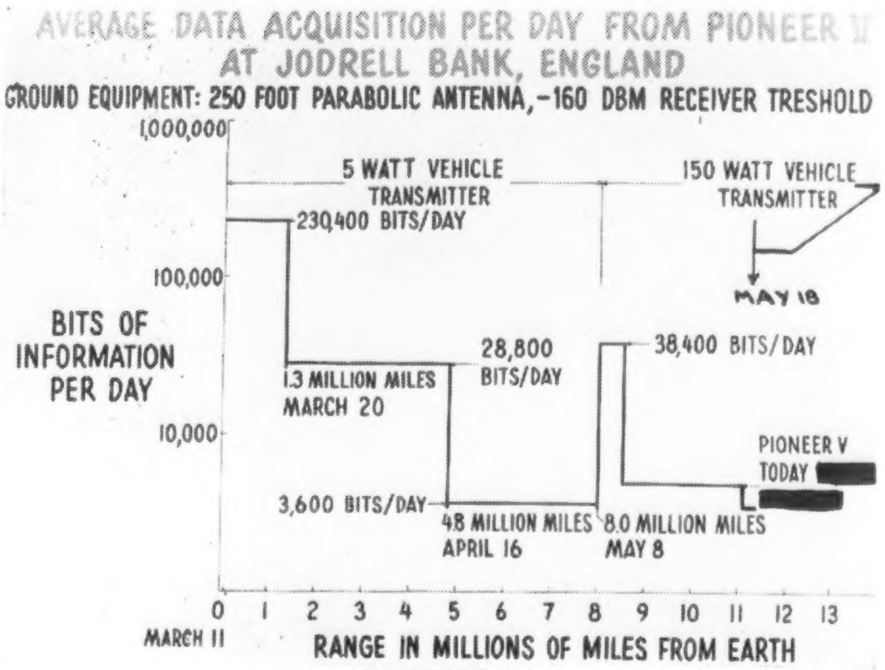


FIGURE 1

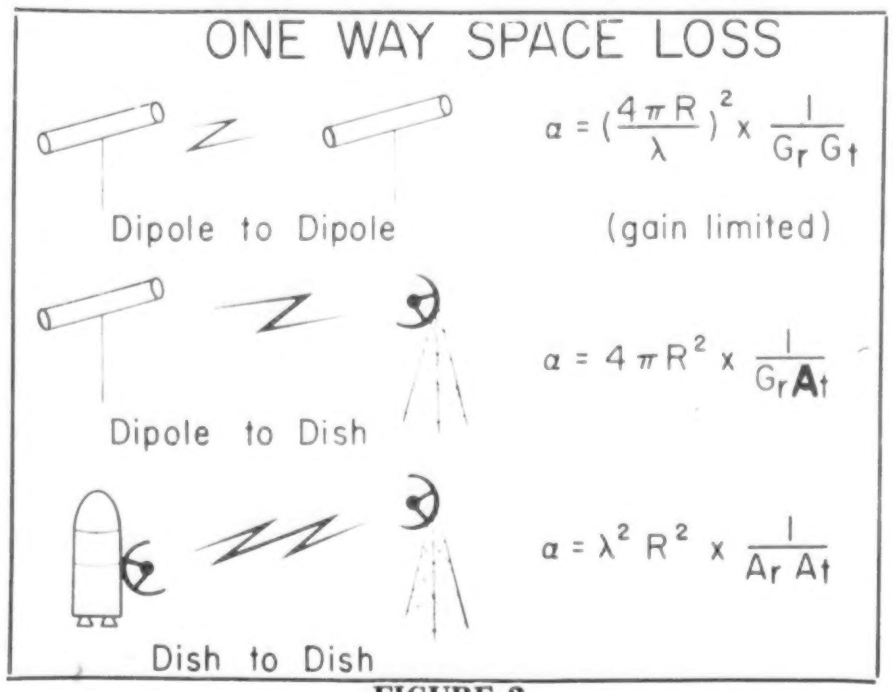


FIGURE 2

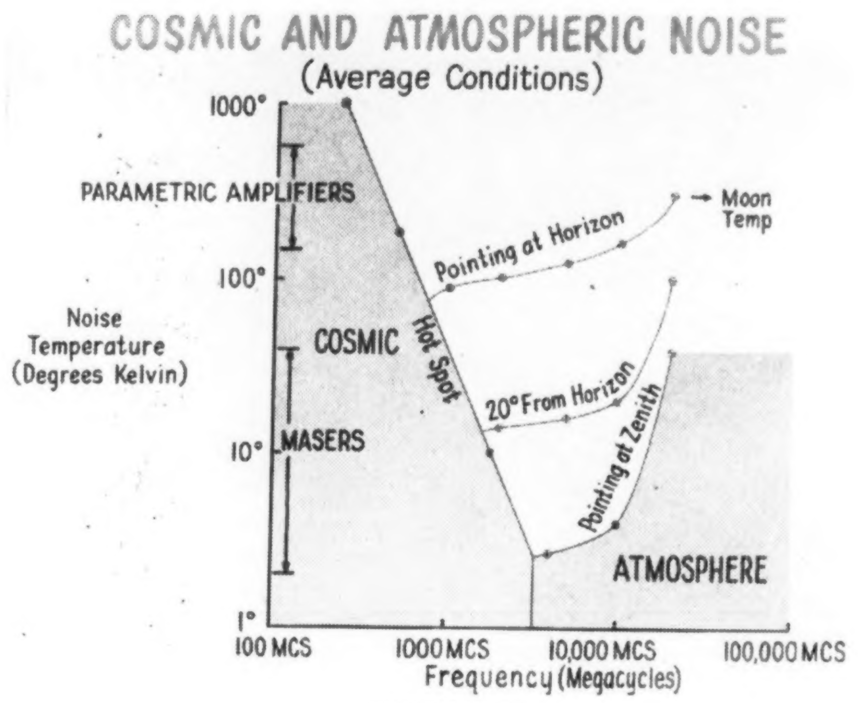


FIGURE 3

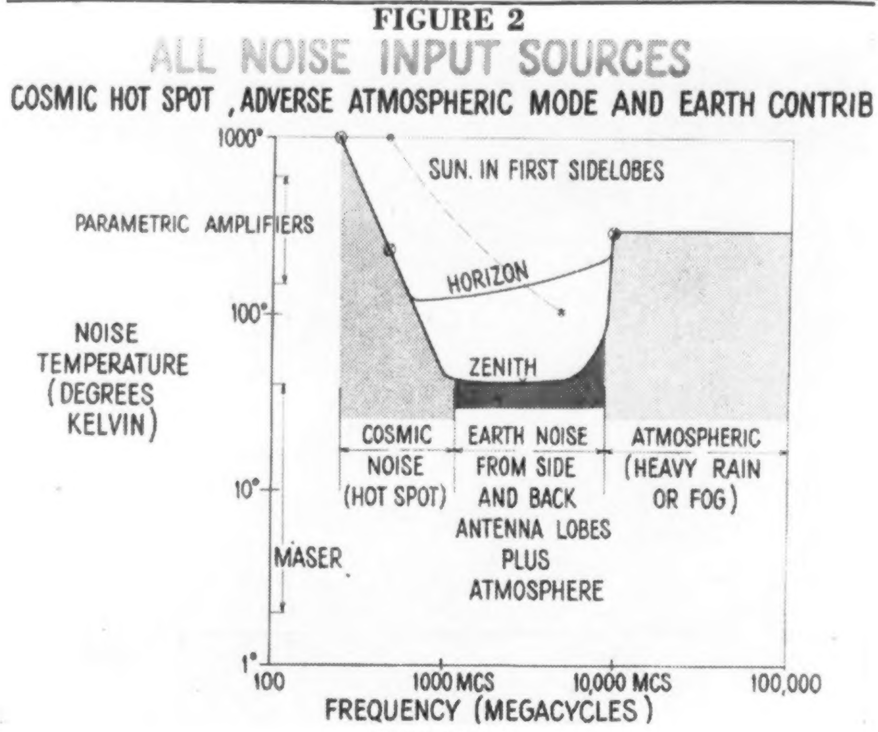


FIGURE 4

Australia this fall. The Goldstone sites are located far from industrial areas and are protected by the local topography from man-made noise.

These stations, using 85 foot antennas in conjunction with directive antennas on the vehicle, will operate for the next few years at about 960 MCS and will provide sufficient space communications capability to handle the NASA deep space exploration program.

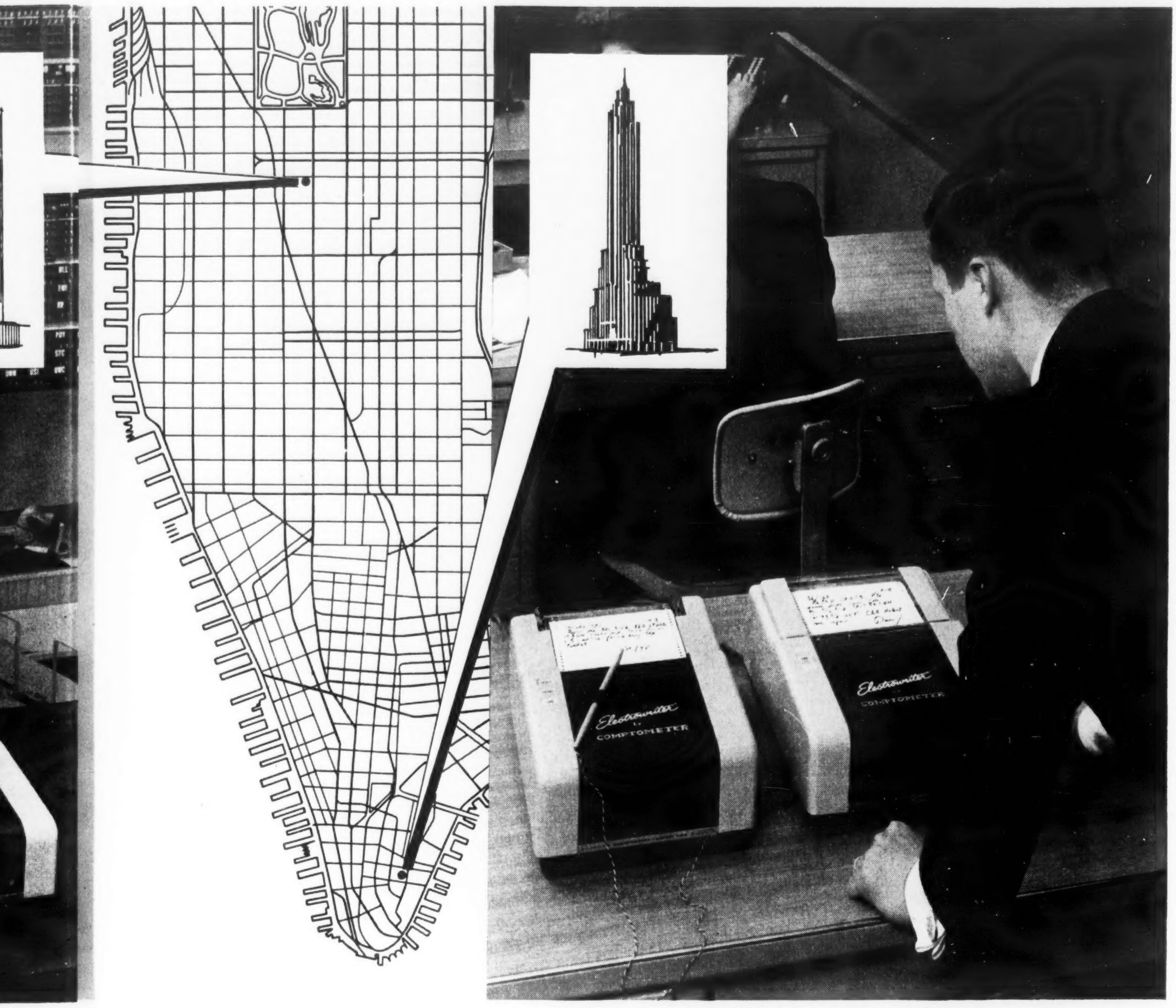
e. *Transmission Loss.* Figure 2 gives three variations of the one way transmission loss formula. The Pioneer series operates in the second equation, which is essentially independent of frequency, with a gain limited antenna on the vehicle and an area limited antenna on the ground. Starting next year, it is anticipated that the third equation will apply with area limited antennas on both the vehicle and ground. This equation indicates that decreasing the wavelength (or increasing the frequency) will reduce the transmission loss. Unfortunately, although true in essence, the reduction of transmission loss with increasing frequency holds over a very limited range of frequency due to technical problems such as antenna surface tolerances. Actually the situation will revert to another form of the second equation with a gain limited ground antenna and an area limited vehicle antenna. The top equation is not applicable to current or near future space communications, but could apply someday when the enormous size of the antennas "gain limit" themselves.

f. *Receiving Systems and Frequency.* It is important to note that the detection of a signal in the presence of noise is generally based on the ratio of these two components. It is obvious that to improve this ratio, one can either increase signal, decrease noise or both. Figure 3 shows the situation with regards to cosmic and atmospheric (oxygen and water vapor) noise. It is interesting that the noise is a function of elevation angle and by restricting coverage to 80 degrees from zenith, a large improvement in over-all noise input results. Also shown is that the maser internal noise level will be at the same relative level as the external noise. Lastly, the figure shows the important problem that a narrow beam-width antenna on earth pointing at a landed lunar vehicle will see a very high noise source (about 250 degrees Kelvin). In this situation the difference between a 10 degree Kelvin maser and a 40 degree one becomes academic. Losses in feed and transmission lines as well as man-made interference also inject noise into the system. In summation, the NASA is currently utilizing parametric amplifier equipment. Maser type receiving systems will also be used as soon as operational problems with these devices are solved, but their effectiveness may be seriously lessened by the previously mentioned noise inputs and other noise inputs mentioned later. With regard to the future, there are two significant improvements to the space communication system being planned. The first is an antenna larger and more effective than the present 85 foot antennas. The size of an antenna is not the primary measure of its effectiveness. Equally important are the accuracy of the antenna surface dimensions and the antenna's susceptibility to extraneous noise. The problem of

(*Continued on page 38*)

How Merrill Lynch, Pierce, Fenner & Smith Inc. solves written message problem between offices

Priority inquiries on margin and cash accounts are instantaneously sent by Electrowriter transmitter from the Merrill Lynch, Pierce, Fenner & Smith Inc. branch office in the new Time-Life Building at Rockefeller Center, New York City . . .



to Electrowriter receiver located at Merrill Lynch main office in downtown Manhattan. Clerk checks credit and debit balance, buying power, and immediately transmits answer back to Time-Life Building with Electrowriter transmitter.

Electrowriter systems provide instantaneous written communication between two or more stations any distance apart. As you write or transmit sketches, the remote receiver simultaneously records the message on paper in your own handwriting. Intermediate handling of messages is eliminated. An accurate record of each transaction is provided. Electrowriter instruments are transistorized, self-contained, and operate over telephone circuits, radio circuits or any pair of wires. Lease terms available. Write Comptometer Corporation, 5600 Jarvis Avenue, Chicago 48, Illinois, Dept. S-7.

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ELECTROWRITER—TRADEMARK REGISTERED, U. S. PATENT OFFICE

Panel Discussions

(Continued from page 35)

surface dimensions is related to wavelength. At certain frequencies, one would do better with a smaller, more precise antenna than a larger, rougher one.

Next, Figure 4 shows the actual noise situation on many present day antennas. The side and back lobes of the antenna pick up thermal noise from the earth. Also one must keep the near sidelobes of the antenna from pointing at the sun or, as shown, a high noise level results. There are several methods being investigated by NASA to reduce such noise inputs to the larger antenna such as the Bell Telephone Laboratory "hoghorn" antenna, reflective earth shielding, tapered illumination, side lobe control, reflector current minimization, etc.

The second improvement would be to increase system operating frequency from 960 MCS to the 2290-2300 MCS band. The reduction in cosmic noise from Pioneer V's frequency of 378 MCS to the proposed 2300 MCS band is over 90%. Also the frequency change will place the system in an allocated "space" frequency band (specified by the 1959 Geneva ITU Conference), where it should receive international legal protection from man-made interference.

These two improvements will not be implemented until after 1963; however, the combination of a larger, more effective antenna operating at the higher frequency of 2300 MCS should further increase space communication range or bandwidth by a large factor.

I would like to acknowledge with thanks the suggestions of Dr. Eberhardt Rechtin of the Jet Propulsion Laboratory and Mr. Wallace L. Ikard of NASA Headquarters.

TRACKING SATELLITES

SPEAKER:

Dr. Robert Coates
Space Aeronautical Scientist
Tracking Systems Div.
Goddard Space Flight Center

At the recent Geneva conference of the International Telecommunications Union, agreement was reached on international clearance of several frequency bands for use by scientific satellites and space vehicles. The frequencies of these new space bands are 136-137 Mc; 400-401 Mc; 1427-1429 Mc; 1700-1710 Mc; and 2290-2300 Mc. The 108 Mc frequency used up to now in U. S. satellites is only a temporary assignment and must be abandoned fairly soon. It is planned that satellites scheduled for launching after 1 December 1960 will use frequencies in the new international space bands.

The planning, development and construction of facilities for satellite tracking and data acquisition in the new frequency bands are under way at the National Aeronautics and Space Administration. By December of 1960 the NASA Goddard Space Flight Center will have in operation a network of radio tracking and data acquisition stations for satellites using the new 136 Mc band. This system is an outgrowth of the highly successful Minitrack system and consequently the new system will be similar to Minitrack in some respects. However, many new features worthy of discussion have been incorporated into the 136 Mc system.

In total, NASA is planning to have 14 stations in the new 136 Mc tracking and data acquisition network. Stations will be located at Blossom Point, Maryland; Fort Myers, Florida; East Grand Forks, Minnesota; San Diego, California; College, Alaska; St. Johns, Newfoundland; Antiqua Island, British West Indies; Quito, Ecuador; Lima, Peru; Antofagasta, Chile; Santiago, Chile; Johannesburg, South Africa and Woomera, Australia. Negotiations are underway for the 14th station to be located in southern England. These stations will provide a truly general purpose satellite tracking and data acquisition network for satellites at any inclination from equatorial to polar.

136 Mc Tracking

The Minitrack system for determining satellite positions is based on the interferometer principle. Two sets of interferometers, one with an east-west baseline and one with a north-south baseline, are used to measure the two direction cosines required for specifying a satellite's position. The long baseline interferometers for the new 136 Mc band will be fitted inside the present 108 Mc interferometers so that the center of the two interferometer systems will be at the

same point. The individual ante
of the long baseline interferom
or "fine" systems, are eight-ele
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The present 108 Mc stations hav
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ties will consist of two differen
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south for low inclination orbits.
the second system will have the l
oriented east-west for tracking s
lites in high inclination orbits.

The 108 Mc ambiguity ante
cluster around the center of the
tenna field. Consequently, the
136 Mc ambiguity antenna con
is located away from the center.
off-center location introduces a s
parallax error in the calibration
this is easily corrected. The 136
ambiguity antennas have symme
ally shaped beams about 75° w
This allows the use of one se
ambiguity interferometers for
high and low inclination orbits.
136 Mc ambiguity antennas will f
a pair of north-south interferome
and a pair of east-west interfere
ters. The baselines of each pair
be 3.5 and 4.0 wavelengths. The
son for selecting this arrangemen
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tennas makes it impractical to di
ly obtain a half wavelength base
An equivalent 0.5 wavelength b
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baselines (57 and 46 wavelength

The 136 Mc tracking receivers
measuring the phase difference
tween antenna pairs will use the sa
principle of operation as used in
present 108 Mc Minitrack receiv
The 136 Mc receivers are triple c
version superheterodyne receiv
with a pre-detection bandwidth of
Kc. Each local oscillator is cry
controlled and tunable in steps
switching crystals. The receiver c
be tuned from 136.0 Mc to 137.0
in 1 Kc steps with an accuracy of
750 cps. The receiver has a no
figure of about 3 db and a dynam

range of 70 db or more. The separation frequency for the two signals is 100 cps. The outputs of each receiver contain both analog and digital phase meters. The system is designed so that one digital bit is equal to approximately 4 sec of space angle in the most sensitive part of the interferometer pattern.

136 Mc Data Acquisition

The main telemetry antenna for the new band will be a self-tracking quad-yagi antenna with a gain of approximately 19 db. The antenna will have crossed yagis permitting diversity reception on two orthogonal linear polarizations, or reception on circular polarization. The 4-yagi elements will be arranged for phase monopulse operation for automatic tracking. The tracking receivers will be very similar to the Minitrack receivers described previously.

The mount for this antenna is its most unique feature. The antenna mount is an "X-Y" mount. It has a primary axis of rotation (X axis) which is horizontal in the north-south direction. Its second axis (Y axis) is perpendicular to the primary axis on which it is mounted. The center line of the Y-axis rotates with the X-axis. For example, when the antenna is pointing to the zenith the Y-axis is horizontal and when the antenna is pointing east the Y-axis is vertical.

This mount was designed specifically for tracking satellites over the entire sky above a 15 degree horizon. The "X-Y" type mounting was selected for two reasons: (1) It has no gimbal-lock positions above the 15 degree horizon; and (2) The ratio of shaft velocity to the tracking velocity is unity at the zenith where satellite angular velocities are a maximum, and the ratio of shaft velocity to tracking velocity is high only near the horizon where the satellite angular velocities are small. With this combination, excessive shaft velocities are not required. The maximum shaft velocity is 15°/sec and the acceleration rate is 5°/sec/sec. This antenna will follow any satellite pass including the close approach of a satellite in a highly eccentric orbit.

Each station will have also a hand-operated telemetry antenna for emergency use. This will be a crossed yagi array with a gain of greater than 14 db. It will have a simple azimuth-elevation mount.

There will be a minimum of two new 136 Mc telemetry receivers at each of the 14 stations in the Minitrack network. The receivers are being developed specifically for data acquisition from satellites. The receiving system will consist of low noise pre-amplifiers mounted on the antenna and the main receivers located in a nearby building. The pre-amplifiers will have a noise figure of 3 db and a bandwidth of 3 Mc centered at 136.5 Mc.

The main receiver will be a triple conversion superheterodyne receiver with crystal controlled local oscillators. The receiver can be tuned from 136.0 Mc to 137.0 Mc in 1 Kc steps with an accuracy of ± 750 cps. The first local oscillator switches frequency in ten 100 Kc steps, the second local oscillator switches frequency in ten 10 Kc steps, and the third local oscillator switches frequency in ten 1 Kc steps.

The receiver has five pre-detection bandwidths: 1 Mc, 300 Kc, 100 Kc, 30 Kc, and 10 Kc. These bandwidths are obtained with three I.F. amplifiers. The output from the first mixer is fed to a high gain I.F. amplifier with a 1 Mc bandwidth. Thus for the 1 Mc bandwidth, the receiver is a single conversion superheterodyne. The first mixer output is also fed through a band pass filter to the second mixer. The second mixer output is connected to a high gain I.F. amplifier with a switchable bandwidth of 300 Kc and 100 Kc. The receiver is a double conversion superheterodyne for the 300 Kc and 100 Kc bandwidths. The second mixer output also goes through a filter to the third mixer. The output of the third mixer then goes to a high gain I.F. amplifier with a switchable bandwidth of 30 Kc and 10 Kc. Essentially the inputs of the three I.F. amplifiers are in parallel because there is unity gain in the filters and mixers. Each I.F. amplifier has its own AGC so that each amplifier is controlled only by the signal it is amplifying.

The outputs of each I.F. amplifier are fed to separate detector chassis. These detector chassis contain an AM detector, an FM limiter and discriminator, a frequency converter which converts the I.F. frequency to a lower frequency, and an output of undetected I.F. signal. The frequency of the converted output is low enough for direct recording on magnetic tape or for feeding a tracking filter. The tracking filter provides coherent phase and AM detection.

Equipment will be available at each station for direct magnetic tape recording of the undetected and detected telemetry signals from the receivers. The combined 108 Mc and 136 Mc stations will have both Ampex FR-107 recorders with a 100 Kc frequency response and Ampex FR-607 recorders with a 250 Kc frequency response. Both recorders have seven tracks. This permits simultaneous recording of the undetected and detected signals from two receivers, the time signals, a standard frequency, and one channel of several sub-carriers for receiver AGC voltages, antenna positions, and other supporting data.

Each station will have only enough data reduction equipment (such as sub-carrier discriminators, decommutators, etc.) to permit the operator to monitor the system operation. It is not planned to have data processing at each station except for special cases where real-time reductions are necessary.

A central data reduction center has been set up at the Goddard Space Flight Center for reducing the data on the magnetic tapes from all the stations. At the present time, this center is equipped to handle PDM/FM-AM and FM-FM telemetry. Instrumentation for other types of telemetry is being acquired, and methods to improve the speed and accuracy of the data reductions are being developed.

ADVANCED TECHNOLOGY FOR SPACE COMMUNICATIONS

SPEAKER:

Dr. Nicholas Renzetti,
Chief, Communications Engineering and Operating Section
Telecommunications Div.
APO, Jet Propulsion Labs.

THE ORDERED investigation of space being conducted by the Jet Propulsion Laboratory under the auspices of the National Aeronautics and Space Administration encompasses the measurements involving practically every scientific discipline presently existing on Earth, and no doubt, if the past decade is a measure, will in the future give birth to a number of additional scientific disciplines about which we are presently most ignorant.

Among the more important areas of investigation, such as radiation phenomena, biological effects and de-

tection, field intensity, confirmation of Einsteinian hypothesis and determination of geologic structures of our close neighbors, we find the need for a basic tool in our mass, length and time coordinate system not only to lend meaning to our other measurements but to provide satisfactory deep space guidance for our lonely Earth-borne space probe. That tool is precision ranging. Data obtained through ranging is of value in: providing basic geometry in solving problems of communications, guidance and tracking; evaluating system performance; interpreting scientific data; and, determining physical constants.

In the deep space exploration program, ranging missions will consist of attempts to determine the distance between two objects of the following four:

1. Earth
2. Celestial Bodies (Moon, Venus, Mars)
3. Earth Satellite
4. Deep Space Probe

For each of the six pairs of bodies thus obtainable, the ranging experiment may involve either the use of passive reflected radiation or active transponded radiation. In practice some of these combinations are more likely than others. For instance, ranging between the Earth and another celestial body can reasonably be expected on both a transponded and reflected basis while ranging from the Earth to a deep space probe would clearly have to be transponded. Again, ranging for final intercept guidance of a deep space probe with a celestial body could certainly be reflective.

Beyond the two-body problem, certain three-body ranging situations exist. A probe traveling in the vicinity of the Moon could compare a ranging signal sent directly from the Earth with the same signal reflected from the surface of the Moon. This method in turn could be related to a Loran type guidance system with a mean baseline of 380,000 kilometers for deep space navigation, or to a homing guidance system for impacting on the Moon. It is seen that many such ranging techniques can exist and you undoubtedly can think of many more. Hence, consistent with our deep space mission it can be seen that a firm requirement exists for the development of theoretical and operational techniques for establishing a ranging system.

It is interesting to note that distances measured in light seconds can be sought with an accuracy equivalent to the stability of the velocity of propagation (one part in 10^8 or 10^9) distance in astronomical units (the mean distance from the Earth to the Sun) and can be correlated to light seconds once the Earth to celestial body ranging measurements establish the conversion factor. Because the distance in miles is a strictly terrestrial unit we can't expect measurements of this unit to be much better than one part in 10^6 or maybe 10^7.

Satisfactory ranging can be accomplished in two rather related fashions, through the counting of the Doppler shifted carrier cycles or through the use of a coded Doppler system. The major disadvantage to a pure Doppler system is that there exists a range ambiguity of one wave length and that range information is lost if for any reason any cycle counts are lost, whereas a coded Doppler system with a code length greater than the two-way transmission time can establish unambiguous range at any time communications are available.

Many of the anticipated ranging missions involve power level and range requirements too severe to be met with ordinary detection methods, and it is necessary that some method of time averaging be used to extract the signal from the high level of background noise (since the noise will average out to zero, the longer we wait, the greater the signal energy becomes). Since range readings need not be made at a high rate (once per second to once per day) depending on the application, a considerable amount of transmitter time can be devoted to obtaining a single range reading. The obvious detection scheme to use under such conditions is correlation detection in which the correlation time can be increased as the noise to signal ratio increases and as the desired range accuracy increases. In correlation detection, the nature of the signal is well known, and its known properties are used to identify it down in the noise. It is much like asking a friend to wear a purple and yellow dress so that she may easily be picked out of a crowd of people. Since discrete binary sequences with exceptionally good auto correlation functions (which may be likened unto the extraordinary ability of one woman to rapidly detect the presence of another woman wearing a duplicate of the hat she is wearing among a large group of other more fortunate females) are known to exist and are easy to generate (as shift register sequences), it is natural to explore the concepts of a ranging system based on pulse code modulation of this type. This binary code schem is also consistent with our require ment for unambiguous ranging. Fur ther, the use of the classical singl pulse radar technique, if unambigu ous ranging is required, would necessitate a pulse repetition rate slowe than the time of the two-way roun trip the pulse would travel, and hence would require unacceptably longe averaging time to pull it out of th noise. The answer at present appear to be periodic repeating code se quences with periods longer than th two-way propagation time previousl mentioned. For purposes of utilizin the desirable properties of phase-loc detection techniques of both the car rier and code, the system planne will incorporate a continuous wav phase modulated technique.

To properly acquire our code, it i necessary that the code have negligi ble use of out-of-phase correlatio as compared to in-phase correlatio so that we have a high confidenc that the code has been properly ac quired. We compare the receive code with a delayed version of th locally generated code and when cor relation is achieved, the range is measured through the delay in the re turned code. The acquisition tim of the code appears to be formidabl at a first glance. By assuming two microsecond code repetition rat and code lengths of ten minutes we see that the number of trial to obtain coincidence approaches i order of magnitude the distance i miles of the range we are trying t measure. This clearly is unacceptable However, if we generate our tota code from number of shorter codes and we choose these shorter code so that their auto correlation func tions allow them to be acquired sep arately, we can decrease our ac quisition time enormously. For in stance, if we have three sub codes o periods P_x, P_y and P_z and combin them such that the sequence lengt is the product of P_x, P_y and P_z, th maximum number of trials woul only be $P_x + P_y + P_z$. If $P_x = 31$, $P_y = 11$ and $P_z = 59$, the perio would be 20,119 elements. However the correlation trials would be n more than 101. In a typical labora tory test of code acquisition of a 10,000 element code with a perio of twenty-one minutes, the longest acquisition time of all three element of the code was less than four min utes. Through the use of phase-lock ing techniques, automatic code sweep ing and locking is possible. Once the lock has been established and the range recorded, it is possible to turn off the ranging system and count Doppler cycles to maintain the range,

thus providing the wide bandwidth necessary for ranging for other data purposes.

The actual system now under development at JPL for Moon probe use has a clock frequency of 500 KC. uses three sub codes and has a total code length of four seconds. The use of Vernier techniques in our ranging equipment will enable range measurement to an accuracy of ± 10 meters. Additional tests on similar equipment with artificial noise added to the correlation process indicated that the code is recoverable with a noise to signal ratio of 35 db, or noise power better than 2000 times the signal power. It is this type of advantage combined with inherent high accuracy that makes the correlation detection ranging system so attractive.

*The author acknowledges the assistance of Dr. E. Rechtin, W. K. Victor, Dr. S. Golomb and J. R. Hall in preparing this material.

UTILIZATION OF SATELLITE COMMUNICATIONS

SPEAKER: Leonard Jaffe, Chief, Communications Satellites, NASA

A WORLD-WIDE instantaneous communications network is certainly a requirement (and probably will be for some time to come) for the safe controlled re-entry of man from space. Such a communications system is extremely difficult to come by with currently available techniques. I believe that it is obvious that there is a real need for more and better global communications facilities both for many other civilian and military purposes. The only reliable trans-oceanic communications today are via submarine cables and these are not adequate either in numbers, the areas covered, or in bandwidth capacity even for current needs. Cables are costly and we do not see much promise for cables with bandwidth capabilities of much over 2 megacycles. Many people, who have studied the alternatives, believe that satellites offer the most promising solution to the global communications problem.

There are a number of types or configurations of communications satellites which can be used, but basically these can be divided into two categories: those which contain electronics—the active repeater satellite, and those which contain no electronics but which merely reflect radio signals back to the earth—the passive communications satellites.

As many of you already know, the NASA is currently investigating the possibilities of passive communications satellites in a program which we call Project Echo. Project Echo is designed to determine the characteristics of a 100-ft. diameter spherical satellite as a communications medium.

Other agencies are investigating the 24-hour active communications satellite. Satellites at an altitude of 22,300 miles would have a period equal to the earth's rotational period and therefore would remain stationary with respect to a point on the earth's surface eliminating the need for steerable ground antennas. Three such satellites could then provide complete global coverage with the ex of the polar regions if th oriented properly. The 24-hou communications satellite m corporate the additional com of systems for controlling the and altitude of the satellite.

Why are we approaching b active and the passive com tions satellites systems? Becau not possible today to sta equivocally which system i There are advantages and di tages to both. The active satell tem requires smaller ground ties, smaller antennas, less tr ter power. The passive satelli tem requires large antennas low noise and, very sensitive ers and very high-powered tr ters on the ground. The activ lite system is subject to com failure. The passive satellite contains no electronics and, a as the structure exists, there i ing in orbit to cause interrup service. The active satellite will have a capability in te bandwidth only to the extent for which it was originally de Its bandwidth cannot be ex when needed without the est ment of new satellites. The satellite is not limited in its fre response and, therefore, it limited in its bandwidth. The system is basically controlled be used by only one user at a A passive satellite system co shared by a number of users same time. These are the pro cons. I cannot say when we wi an operational communications lite system, nor what the ul communications satellite will b of this I am confident—satellit one day provide this service a it economically and efficiently.

Panel II

Space Communications

BY BELL TELEPHONE LABORATORIES, INC.

PROBLEMS OF SATELLITE COMMUNICATIONS

SPEAKER: Dr. J. R. Pierce, Bell Laboratories

THE BELL SYSTEM has a long history in transoceanic communication. Radio telephony between Arlington, Virginia, and Paris and Hawaii was first demonstrated by American Telephone and Telegraph Company and Western Electric Co. in cooperation wit United States Navy in 1915. T atlantic long-wave circuits were p

to commercial use in 1927, and the first commercial short-wave radio telephone circuits were put into service in 1928. In 1956 a voice frequency telephone cable of 36 channels, now expanded by various means to more than 90 channels, was put into use between the United States and Scotland. We now have a cable to France that serves the western Continental Europe, a cable to Cuba, a cable to Hawaii, a cable to Puerto Rico, and a cable to Alaska, and other underseas cables have been projected.

If you cut the United States in two, right around New York or across the mid-west or almost any place, you will find about 100 megacycles of assorted Bell System circuits crossing that cut. This allows not only thousands of telephone channels but also many television channels. If you add up all of the overseas circuits, including not only cable but short-wave radio, which is sometimes a very imperfect medium indeed, you will find that leaving the United States there is only about one megacycle total bandwidth, about a hundredth of that you have crossing a line across the United States. This is despite the fact that there are many more people outside the United States than inside the United States and that the telephone network outside the United States is growing.

You also will find that the cost of the first transatlantic cable, which provided 36 telephone channels and no television, was just about the same as the cost of the first transcontinental micro-wave radio relay system which provided thousands of telephone channels and several television channels. Now, although broader band cables are projected, the overseas traffic has increased with the advent of good cable circuits, and one can barely keep up with the need. There is a need for more service for both commercial and military purposes. Particularly there is a need for alternative means of communication across the oceans to insure reliability, especially in case of emergency.

More Overseas Circuits

Recently, satellite communication has seemed to be an attractive way of getting many, many more overseas circuits than we have ever had before. It would enable one to use microwave radio, which we use so successfully in crossing the country. Radio waves travel in straight lines. Short-waves radio gets across the ocean rather erratically because it is reflected by the ionosphere, but microwave frequencies would go right out into space. Of course, if one had a satellite that was mutually visible from both sides of the ocean some of the microwave signals could be either reflected or retransmitted back to the other side.

Here we have several alternatives. Consider low versus high satellites. If you put satellites up just a thousand miles, or a few thousand miles, they would be periodically visible from both sides of the ocean. You would have to track them, but if you had a lot of satellites you could get a circuit across the ocean.

If you had satellites up 22,300 miles above the equator in the circular equatorial orbit rotating in the same sense as the rotations of the earth, they could in principle stand still with respect to any one point on the earth. In that case there would be no need for tracking them with the antennas. You could point your antennas in a constant direction at both terminals and have a circuit all the time. This requires, however, accurate station-keeping equipment on the satellite. It also requires long-life accurate orientation, because you would need directive antennas for this sort of service. It is very attractive in the long run. One could imagine tens or even hundreds of such satellites providing circuits between here and there.

The only disadvantage of the 24-hour satellite is there is a delay. If you said hello into such a system, it would be 6/10ths of a second before you would get a reply. In connection with echo suppressors, which render the circuit essentially a one-way circuit, this delay can sometimes introduce trouble. Nonetheless, 24-hour satellites are attractive. We have to study this problem of delay, however.

What Do We Need?

What is needed to achieve useful satellite communications? Is it new ideas? Satellite communication appeared in science fiction many years ago. Arthur Clark suggested the stationary 24-hour satellite in *Wireless World* as long ago as 1945. I looked into several satellite communications systems in an article published in *Jet Propulsion* in 1955. This discussed low passive reflectors or higher active satellites, consisting of radio receivers and transmitters. Rudolph Kompner and I published later details in *Proceedings of the I. R. E.* in 1959. More has been published in other places. I think that all of the general ideas about satellite communications have been apparent for many years.

Do you need breakthroughs? As far as I can see the first great breakthrough was Newton's Laws of Motion in the 17th century. Radio came in the last century. Electronics came to us with the invention of the audion in 1907, and with Varian's invention of the klystron and Kompner's traveling wave tube, and the transistor by Brattain, Borden and Shockley. All the fundamental ideas that one needs, including a later invention, the maser, seem to be at hand.

Another great breakthrough was the demonstration that rockets are really possible. The German V-2 and the later work in this country and other places demonstrated this fact. It isn't exactly breakthroughs that one needs. All the general ideas exist in some form.

One does need something else, however, to have practical satellite communications. One needs new knowledge. Right now we need further knowledge of propagation, and especially of atmospheric noise and attenuation during rain. Another thing we need is the successful application of known techniques to the job at hand. It is very easy to throw things together and make them work after a fashion, but a successful system requires something else. It requires reliability and long-life.

Some of the things that we need to explore are low noise receivers, masers and antennas with high discrimination against noise and against interference from other systems and with other systems. In the case of active repeaters, we need long-life devices that will last much longer in orbit than the things that have been shot up in exploratory satellites seem to be lasting.

First, I will discuss the matter of low noise receivers. The signal received from a passive satellite is very weak indeed, and the transmittal power for a useful system will be high at the best. If the noise in the receiver can be cut down to a hundredth of what it might be with some other receiver, then the transmitter power can be cut by a hundredth, or a smaller antenna can be used. This is very important in trying to use passive repeaters.

In trying to use active repeaters, it is hard to imagine putting up hundreds (or even tens) of watts in a satellite because of the weight problem. Also, the use of high powered transmitters in orbit would interfere with microwave systems in other lands. Here again, it is desirable to have as sensitive receivers as possible, so that you can keep the transmitter power of an active satellite down to a minimum. Fortunately, in the three-level maser invented by Bloombergen at Harvard and realized by Scolvil, Feher and Serdel at the Bell Laboratories, we now have perfectly phenomenal radio receivers.

We are all familiar with the fact that red-hot objects give off electromagnetic waves of light and heat. They also give off electromagnetic waves of microwave. This thermal emission gives us a standard of power, or of noise. If a radio antenna is pointed at a very hot object, you get from the hot object a noise power proportional to the temperature above absolute zero Kelvin or Centigrade (about 469 degrees below zero Fahrenheit).

It is easy to imagine that if the object were red-hot, it would send an appreciable signal to the receiver, but as long as the object that your antenna is pointed at is above absolute zero, you will get some microwave radiation from it. The sensitivity of the maser is such that if the input of the maser is an object of room temperature, the received noise would be overwhelming compared with the noise generated by the maser. In fact, if an object ten degrees above

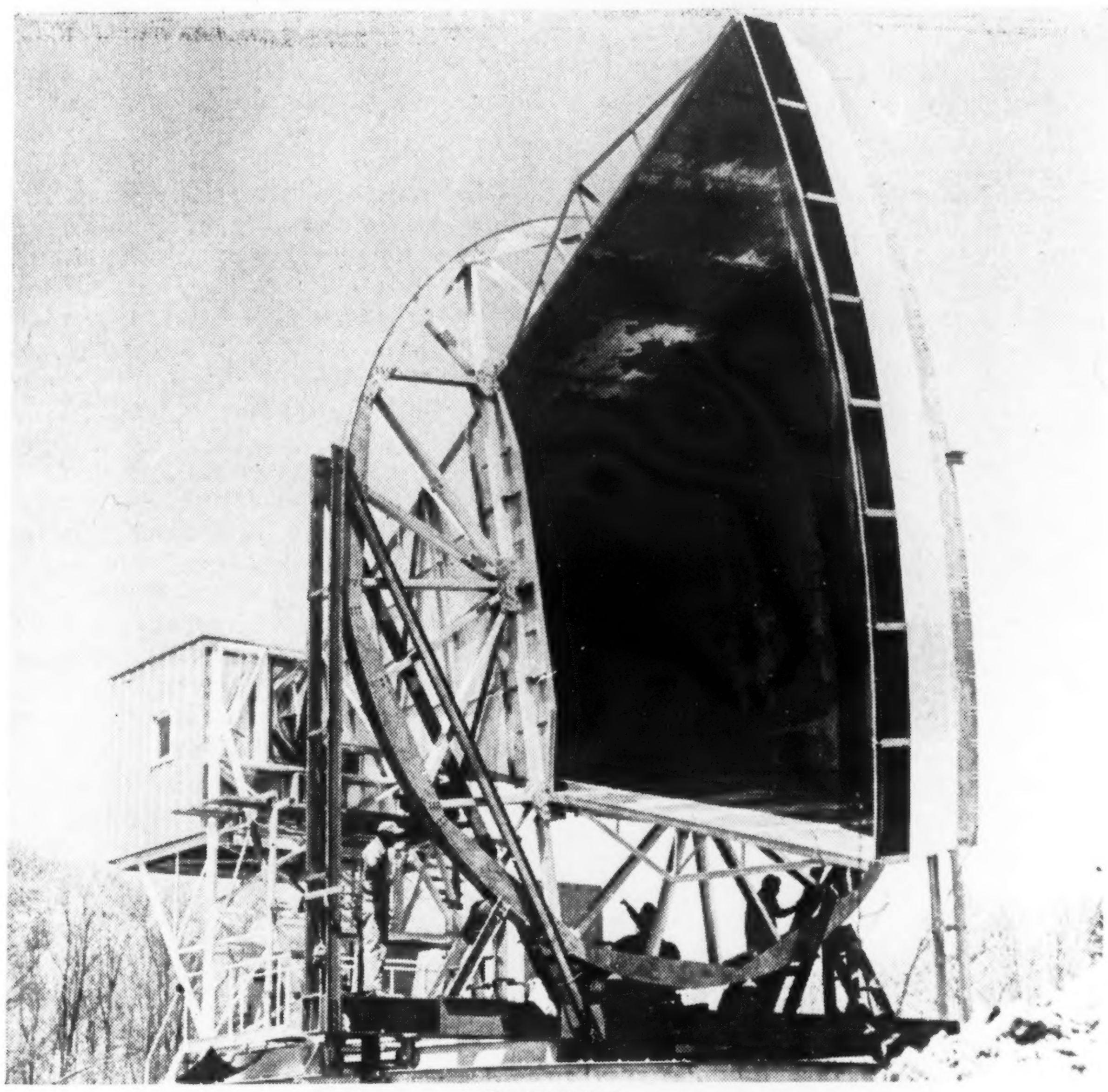

FIGURE 1

absolute zero temperature were used as a signal source, the output of such a maser would be doubled. The electromagnetic radiation from something ten degrees above absolute is equal to the noise generated in the maser itself.

This is possible only because the maser receiver is held and operated at a temperature a few degrees above absolute zero. This temperature is obtained by means of liquid helium. The maser can have gains of over 30 db. and band widths of many tens of megacycles. If the maser were pointed at an object just a little bit above absolute zero, its noise would be comparable to that emitted by an object only a little above absolute zero. Of course, this means that very, very weak signals can be detected by using a maser.

To use the maser, it is necessary to have a very high-quality antenna. If the antenna were to be pointed at the earth, you would get so much noise from the earth that the low-noise maser receiver would not be of any use to you. Indeed, ordinary antennae have enough side lobes and back lobes so that the maser is ineffective with them, because of the noise received from the earth. Fortunately, we have a type of antenna, which was first made for microwave systems. This is the horn reflector antenna, which has a back and side lobe gain of only about a hundred-millionth of its forward gain.

Figure 1 shows a horn reflector antenna. You can see that it is a big horn with a parabolic segment at an angle at the mouth. The radio signal is directed by this horn at the parabolic segment. This is all boxed in, so that nothing can be radiated out to the sides or to the back. Such an antenna has very little sensitivity to the sides or the back, and gives a very good sharp beam in the forward direction.

When a maser-receiver is connected to this sort of antenna, the over-all receiving noise temperature is equivalent to the noise radiated by an object just 20 degrees above absolute zero. This is about 100 times as sensitive as the receivers using crystal mixers that were available a few years ago. It is about 10 times as sensitive as the parametric amplifier receivers that are in use now.

When you have such a very sensitive receiver, you wonder whether you are going to be able to use it. Certainly, if you were receiving signals from something on earth a very sensitive receiver would not be much good, because the noise radiated from the warm earth would interfere seriously. But when we are thinking of satellite communication, we are thinking of pointing the antennae at the sky. Is there some noise there that might overwhelm one? Here one needs, not new apparatus, but new knowledge.

If you operate at low frequencies, you receive cosmic noises—cosmic noise gets greater and greater the lower the frequency is. This is noise from the galaxy that was discovered by Carl Jansky back in the thirties. Above 1000 megacycles, however, cosmic noise is quite small, even at maximum, and will not interfere seriously with reception.

There is another noise, however, and that is noise due to the atmosphere. The atmosphere is hot, not cold like space. If the atmosphere were perfectly transparent, you would not see it. You would see the space behind, and you would not get much noise. The atmosphere is not perfectly transparent, however, and so you get noise from it. You get more noise at higher frequencies.

You can see that the experimental measurements of sky-noise agree almost exactly with the calculated sky noise. Thus, we believe that the sky noise is low, and that we can really cash in on the maser receiver for satellite communication.

Further things are necessary. During ordinary rain, the noise goes up a few degrees. During a particular and peculiar rain that we had, the noise went up very high. This means that one not only has to calculate the sky-noise and verify it, but one has to study noise over a period of time, during the various weather conditions, in order to be able to design sensible satellite communication systems.

BELL LABORATORIES' PART IN THE ECHO EXPERIMENT

SPEAKER:

W. J. Jakes
Bell Laboratories

MOST OF YOU are probably somewhat acquainted with the Project Echo experiment, but let me just briefly review some general aspects to establish our frame of reference.

Some time this summer NASA hopes to put a 100 ft.-diameter plastic balloon into a roughly circular orbit at an altitude of about 1000 miles, with an inclination somewhere near 50 degrees. This balloon will be visible pretty generally over the United States. The Bell Telephone Laboratories (BTL) are participating in the experiment in cooperation with NASA and with their subsidiary, Jet Propulsion Laboratories (JPL), located at Pasadena, California. JPL has a tracking station at Goldstone, out in the Mojave Desert about 100 miles east of Los Angeles. What we hope to do is to demonstrate two-way voice transmission from our station at Holmdel, New Jersey, to the JPL station at Goldstone. We will transmit to them at 960 megacycles by reflection from the balloon, and they will transmit back to us at 2390 megacycles, also by reflection from the balloon.

One of our main objectives is to demonstrate the two-way voice transmission. Our bandwidth will actually be about 3 kilocycles, and we will have the facility for just one telephone channel. We also hope to obtain fundamental data with regard to microwave propagation through the atmosphere and the ionosphere. We will also learn how the balloon itself behaves—if it is indeed spherical. We expect a certain performance and we hope that this is verified. We also are engaging in this experiment to test and demonstrate the use of certain components which Dr. Pierce has already mentioned, such as the horn antenna, masers and certain kinds of tracking systems, all of which might find eventual use in a practical satellite communications system.

Another objective, of course, is to test and demonstrate the feasibility of placing a balloon of this type into orbit. Naturally, if and when the balloon does go into orbit, it will have other possible benefits. We may, for instance, get some information about the atmospheric density at these altitudes.

The last objective, perhaps, is to test and demonstrate various methods of tracking such a balloon, as the methods might be germane to a satellite communications system.

Now let me give you some information about the balloon.

Figure 1 is a picture of the balloon, taken in a dirigible hangar. The balloon is 100 feet in diameter, and is made of Mylar about ½ mil thick; on the outside of the Mylar is a vapor-deposited coat of aluminum about 2500 angstroms thick. Over that is a protective coating composed mainly of a silica compound which will tend to mitigate against damage of the Mylar itself.

The balloon itself weighs about 130 some pounds, and will be inflated by two solids. One solid will be benzoic acid, which will sublime rather quickly when the heat of the sun strikes it. We expect some micrometeorite punctures, of course, and in order to try to maintain a positive pressure over a longer period of time, another solid is also being included, which would sublime at a slower rate after the benzoic acid has been used.

The balloon is actually fabricated out of a number of gores or "orange peels," which are in effect pasted together in an overlapping manner. Some tests have already been made on the reflectivity of this type of construction, with very satisfactory results.

I think most of you have seen or heard of some preliminary tests that have been made already on the balloon and its ejection mechanism; these have been called "shot-puts." They have taken place at Wallops Island, Virginia. I will mention more about our participation in one of these tests further on.

At present there is a possibility—no certainty—that a beacon might ride with the balloon; this is under study. If a beacon (which would radiate at 108 megacycles) does indeed ride with the balloon, this would ease the tracking problem considerably.

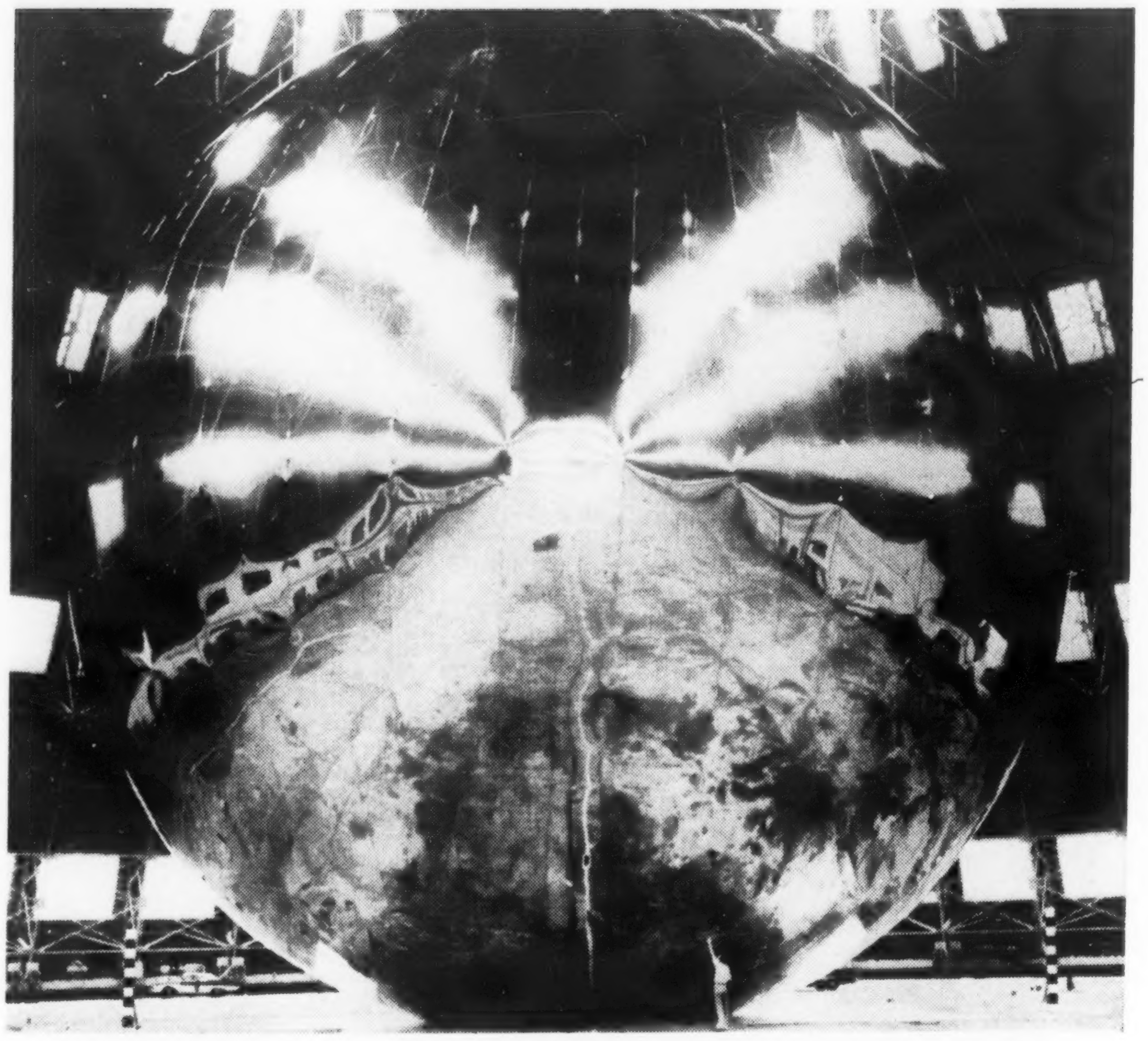

FIGURE 1

Now, let me describe the BTL communications station.

Our hilltop facilities consist of a 60-ft. diameter dish, the 960 megacycle transmitter, a control building where we locate all the operational controls for both transmitting and receiving, a trailer housing our optical tracking gear and the horn antenna. This will be used to receive at 2390 megacycles. Another building houses the servo drive equipment for the horn, and also a gaseous-helium recovery plant in case a helium shortage does develop. We intend to capture all the exhaust helium that comes off the maser and rebottle it, and then send it back for liquifying again.

Let me give some of the details of the elements of this system. The 60-ft. dish has a little over a degree total beam width and a gain of something on the order of 43 db. We have had it equipped with a feed that will transmit any polarization — circular, right- or left-handed, or linear. We intend to use circular polarization on the Echo experiment.

The transmitter, again, is a commercially available item, a so-called "shop" item, which we will use mainly to transmit frequency modulation, and possibly single sideband. When we transmit FM we will be transmitting a fairly wide deviation of about plus and minus 30 kc. The transmitter power is about 10 kilowatts, with a klystron as the final amplifier.

The horn antenna has a beam width about equal to that of the dish—about one degree—and has an effective noise temperature contribution something on the order of 2 degrees Kelvin. In the small cab on the back of the horn we have the RF receiving equipment, namely, the masers; we are providing means to receive both the right-hand and left-hand components of the incoming circular polarization. Thus we have two masers in one package, both having about a 20 megacycle band width, roughly 34 db of gain, both mounted in a single Dewar flask with a single permanent magnet. These are ruby masers. The active material is the chromium in the ruby.

In the control building we house the FM with feedback demodulators. I should mention that we intend to use wide deviation FM on this experiment, about plus or minus 30 kc, and we will receive this with an FM with feedback demodulation system as described and invented by Chaffee seven years ago.

The noise band width of our receiving system is about 6 kilocycles; in other words, we have a feedback factor of about 20 db, which would mean a corresponding increase in the baseband signals/noise ratio. I might quote what we hope and expect to get if the experiment works as we think it will.

At 960 megacycles, the received baseband signals/noise ratio should be something on the order of 50 db; at 2390 megacycles it will be some 10 db better, or about 60 db.

One serious problem in trying to perform an experiment of this type is: how do you point all these antennae at the satellite? We only have a maximum of about 15 minutes per pass to

(*Continued on page* 48)

man and the moon

Man has been looking at the Moon for centuries—wit wonder, sometimes with fear and often in ignorance. I the past year, we have seen photographs of the hidde side of the Moon. Also we have all read the report about Man's first physical impact on the Moon. In Janu- ary 1960, the Nation's press witnessed a new mode o communications designated Communication Moon Re- lay. This system, which uses the Moon as a passive re- flector for relaying radio signals, has been used to pass operational messages when ionospheric storms disrupt other systems. The first public demonstration of the Moon Relay System opened the 14th Annual Convention of AFCEA. In 1960-61 we may expect to see further advances in Man's efforts to explore space. We may see a man in space, or perhaps a man on the Moon. What- ever we see, the 15th Annual AFCEA Convention will provide the thorough, factual information not only on the technological achievements which made these ad- vances possible but also visionary displays of things to come.

15TH ANNUAL AFCEA CONVENTION • JUNE 6, 7 AND 8, 1961

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The seven AFCEA Regional Vice Presidents (L to R): W. H. Pagenkopf, W. K. Mosley, Ray E. Meyers, S. H. Simpson, Jr. (representing Maj. Gen. H. Reichelderfer, USA, Ret.), G. D. Montgomery, P. H. Clark and G. C. Ruehl, Jr.

W. J. Baird, AFCEA Gen. Mgr., hands B. H. Oliver, AFCEA Pres., the winning ticket for the Hoffman transistor radio as Allan L. Eisenmayer watches. Lt. (j.g.) Charles Bollinger, USN, winner, receives his prize from J. R. O'Brien, executive of Hoffman Electronics Corp.

(Left) Maj. Gen. Harry C. Ingles, USA (Ret.), greets Maj. Gen. H. W. Grant, USAF, before the Industrial Luncheon. Also pictured are (L) Thomas B. Jacocks and (R) Philip B. Taylor, Asst. Secretary of the Air Force (Materiel). (Right) Banquet guests as they enter Sheraton Hall.

Panel Discussions

(*Continued from page 45*)

do this. We are providing three basic methods for tracking.

Primarily, we will expect to receive digital data from the Goddard computing center here in Washington, which will give us the look angles—the pointing angles—at Holmdel every two seconds during the pass. Each two-second data point will include five items: the time of the data, the local azimuth and elevation, and also azimuth and elevation rate, which are essentially just the differences between the present point and the next point two seconds away. We have what is essentially a computer on site. This will take the data (which comes in the form of a teletype tape) and grind out for the servos the actual angles which are sent to the antennae. It also does an interpolation using the rate information, so that the antennae receive pointing data at about a 50 cycle rate during the interval between the complete data points themselves. So that we have sort of a combination digital-analog pointing system: the data is received digitally and then is transmitted to the antennae in an analog fashion by a normal 36-to-1 two-speed servo system.

The second method of tracking which we hope to have in operation by the time the balloon actually goes into orbit will be a tracking radar. It is not a radar in the usual sense—we don't expect to get any range information out of it—but we will use the 960 megacycle transmitter to send an auxiliary signal about a megacycle away from our communications channel via the 60-ft. dish to the satellite and then back to an auxiliary 18-ft. dish for reception. This 18-ft. dish will be equipped with a simple conical scan, and hopefully we will get the angular error information so that we can indeed track the satellite.

The third back-up is the rather obvious one of the optical tracker. It has the obvious disadvantages of rain and clouds and sunshine and visibility times; but it certainly would be a very valuable last-ditch resort if the other two systems did not work out.

We have had our equipment in operation for some months now, and have been engaging in several operational tests. One very useful sort of test is a simple moon bounce, which we have done quite a number of times with the Jet Propulsion Laboratories and also with Jodrell Bank. We have two motives for doing this kind of test.

One is that it is a very useful pre-calibration system checkout. Doing it now when we have time, we can set up certain nominal received-signal levels and system-performance parameters which we can then use just before a pass of the actual satellite, to make sure that both ends of the path are indeed in proper operational condition.

As we carried out some of these preliminary tests with the moon, we became more interested in them just for their own possible value. I think we can second some of the other people's feelings about the different kinds of modulation systems on the moon; mainly, that FM does not work too well, and the wider you modulate the worse it works. Narrow-band FM and narrow-band phase modulation, on the other hand, are reasonably useful; and certainly you can get an intelligible voice channel using this type of modulation. Here the RF band width would be on the order of a few kc. Single sideband, on the other hand, as was already demonstrated by M.I.T. transmitting to Jodrell Bank, is quite good; and we have verified this. The results of these studies are leading us farther along and we hope later on to make some more detailed studies of moon transmission.

Another operational test that we have performed with JPL is to bounce signals off Tiros, the weather satellite. Tiros is only 42 inches in diameter and 16 inches high, and is a rather small radar target. However, by using very narrow band widths at JPL, they were able to receive our signal for about two minutes during several passes. The encouraging thing to us is that we and they were both tracking at the time on predicted-orbit data from the Goddard computing center which was supplied to us in the manner that we will actually use in the Echo experiment. This constitutes in part a system checkout and we are very happy to have made it. It was a little difficult, because the actual mutual-visibility time corresponded to elevation angles at both stations that are quite low and we actually had to hand-crank in corrections for refraction in the lower atmosphere.

The third operational tests that we have performed have been in connection with the shot-put tests from Wallops Island. On the third shot-put, which was some time in February of this year, we transmitted 960 megacycles to a receiver located at Round Hill, Massachusetts, in co-operation with the Lincoln Labs. They had a 28-ft. dish there equipped with two receivers, one for vertical and one for horizontal polarization. The audio was recovered with one of our FM with feedback demodulators. We transmitted circular polarization to the balloon, 10 kilowatts at 960 megacycles. We were equipped for continuous optical tracking at this time, and could indeed follow the balloon on the telescope, and were pointing at it continuously. On the other hand, at the Round Hill station the dish was not intended to do this kind of tracking. What they could do was to track with an optical telescope equipped with a read-out and then an operator at the dish controls could job the antenna ahead of the position indicated on the read-out, then stop and let the balloon slide through the beam; thus we were able to get intermittent transmission from Holmdel to Round Hill—both on the vertical and horizontal polarization they re[…] signals.

One further thing I would li[…] mention is that on this test the ba[…] turned out not to be fully inflate[…] fact, the cross-section was some[…] like 4 db down from the nomin[…] cross-section, which means pro[…] about a 70-ft. effective nominal d[…]ter. Here is a case of a balloo[…] being fully inflated, not pro[…] spherical, not properly smooth[…] yet we were still able to get good[…]ity voice transmission during thos[…]riods of time when both antennae[…] pointed at the balloon.

(Editor's Note: At this point[…] Jakes played a magnetic-tape reco[…] of the voice signals received at R[…] Hill during Shot-Put #3 so the [...]ence could note the times when[…] audio came in clear. The transm[…] consisted of four 45-second voic[…]quences spaced one minute apart. [...] first and second voice sequences [...] received on a horizontal polariz[…] The third and fourth voice sequ[…] were received on a vertical pol[…]tion. An additional voice sequenc[…]lowing the Shot-Put was a troposp[…] scatter test for comparison pur[…] with approximately the same rec[…] power.)

The audio was actually supplied[…] programmed tape which containe[…]ternate periods, one minute eac[…] voice and one minute of silence[…] there were times when both ante[…] were pointing at the balloon when [...]ally no audio was received. The [...] drops right out of sight during [...] times, so that we would have got[…] very good-quality voice circuit at [...] times.

ACTIVE SATELLITE REPEATERS

SPEAKER:

L. C. Tillotson

Bell Laboratories

SHORTLY AFTER the end of World [...] II, there was constructed in [...] United States a rather extensive [...]phone network using microwave r[…]

While there are a lot of commu[…]tion facilities in the United State[…]self, there is relatively little conne[…] between this network and those in [...] countries. In fact, this network s[…] on both coasts. All we really nee[…] order to extend this network ove[…]

by means of microwave radio is some place to put the repeaters and the advances in space technology promise us just such a platform.

The most elegant platform for an active repeater is the synchronous repeater in a circular equatorial orbit because it gives us a platform, some 22,300 miles high, which remains stationary. The very distance to this remote point, however, brings its own penalties. Dr. Pierce has already mentioned the delay that's involved, and in a two-way telephone circuit this is at least an important matter, if not a serious one. Further, the radio propagation losses which are sustained in distances as large as this require, either in the case of an active or a passive repeater, some sort of directivity. We'd like to use a directive antenna or some sort of shaped reflector. This can be done, but it entails the attitude stabilization of the platform. Also, if the platform truly is to remain stationary over a given point on the equator, some means for position and orbit control will have to be used.

There are many ideas for achieving these two stabilizations, and I'm aware that some of them are being worked on. However, this problem is at least as complicated, if not more so, than the communication problem itself. There is a real problem, in our opinion, of the reliability of such a stabilized platform.

In our active repeater work we are much interested in this 24-hour synchronous repeater, however. At the present time we are not planning a repeater to go on such a platform, but we are so designing our experimental system that the same electronics can be used in the 24-hour platform when it becomes available. We have on the east coast of the United States an antenna that sweeps out a cone, and a corresponding antenna located some place in Europe. We visualize a satellite in orbit, in either a circular or an ellipsoidal orbit. We have to get up somewhere near 2000 miles in order to make even an experimental circuit of this system. In fact, we have chosen—tentatively, at least—an altitude of about 2500 miles, the argument being that if we develop a satellite to work at this altitude with an essentially zero-db gain antenna, the same electronics can then be used in the 24-hour orbit (which is roughly ten times as high) with a 20-db gain antenna. The path loss turns out to be about the same.

A 2500-mile-altitude satellite will give us about 30 minutes' mutual visibility on the best pass; while this one satellite wouldn't be suitable for an operational system, it is quite adequate for a test of the electronics involved.

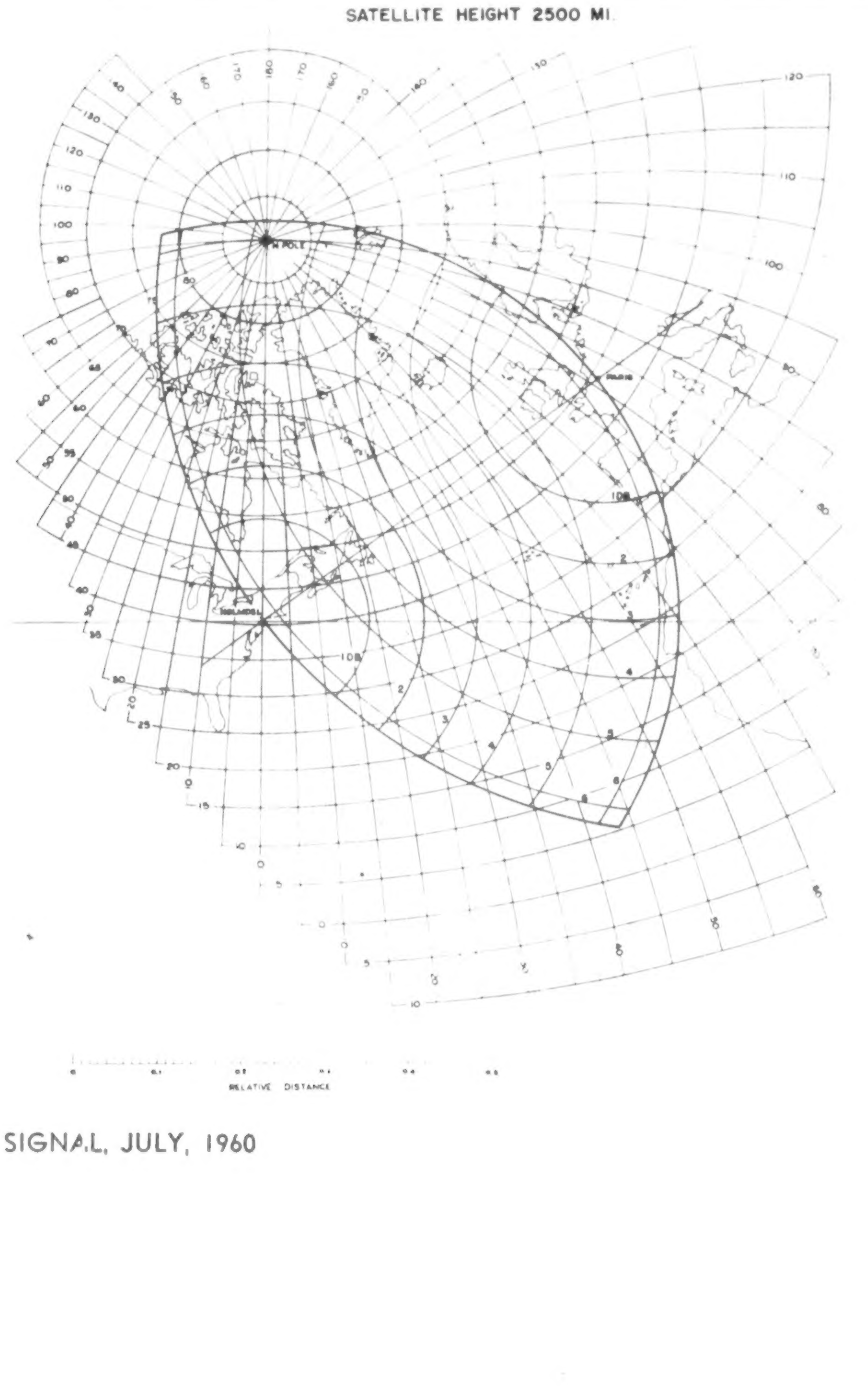
Figure 1 is a plot of the various path losses involved. It is intended to emphasize the small change in path loss as the satellite moves over the surface of the earth. The reference point here is with the satellite directly overhead, that is, with the satellite equidistant from either the eastern or western terminal. As you can see, the path loss increases about 6 db at the limits of the mutual visibility region. This is characteristic, we think, of paths to and from satellites: whereas in ordinary line-of-sight paths we experience fades of 40 and 50 db, the fading should be much less on a path of this sort; this makes possible modulation techniques and approaches to the problem that would not be feasible on an ordinary line-of-sight system.

The minimum path loss between the 60-ft. dish which we have assumed and the unoriented satellite with an essentially isotropic antenna is about 125 db. We have assumed that the ground receiver doesn't have a maser and that the over-all effective noise temperature of the receiver is about 30 degrees Kelvin.

I call your attention to two parameters. One is the power of the ground transmitter; the other is the power of the satellite transmitter. For space systems, both of these are relatively small. These low powers are made possible by using a large index modulation system in which we trade band width for signal-to-noise. The advantage in the case of the ground transmitter is partly a matter of economics, but in good part also it alleviates the interference problem.

In the case of the satellite, the situation is much more critical. In the first place, we don't have a lot of power available, and secondly, we don't have available to us long-life tubes of high power. We believe—and I will try to illustrate shortly—that we can build a one-watt transmitting tube to go in the satellite which will have a very long life. If we tried to solve this same problem at the hundred-watt power level (which we would have to use in order to get the same signal/noise ratio), we would have a problem that at the present time we don't know how to solve.

The experimental system, as you can see at the bottom of this slide, is ex-



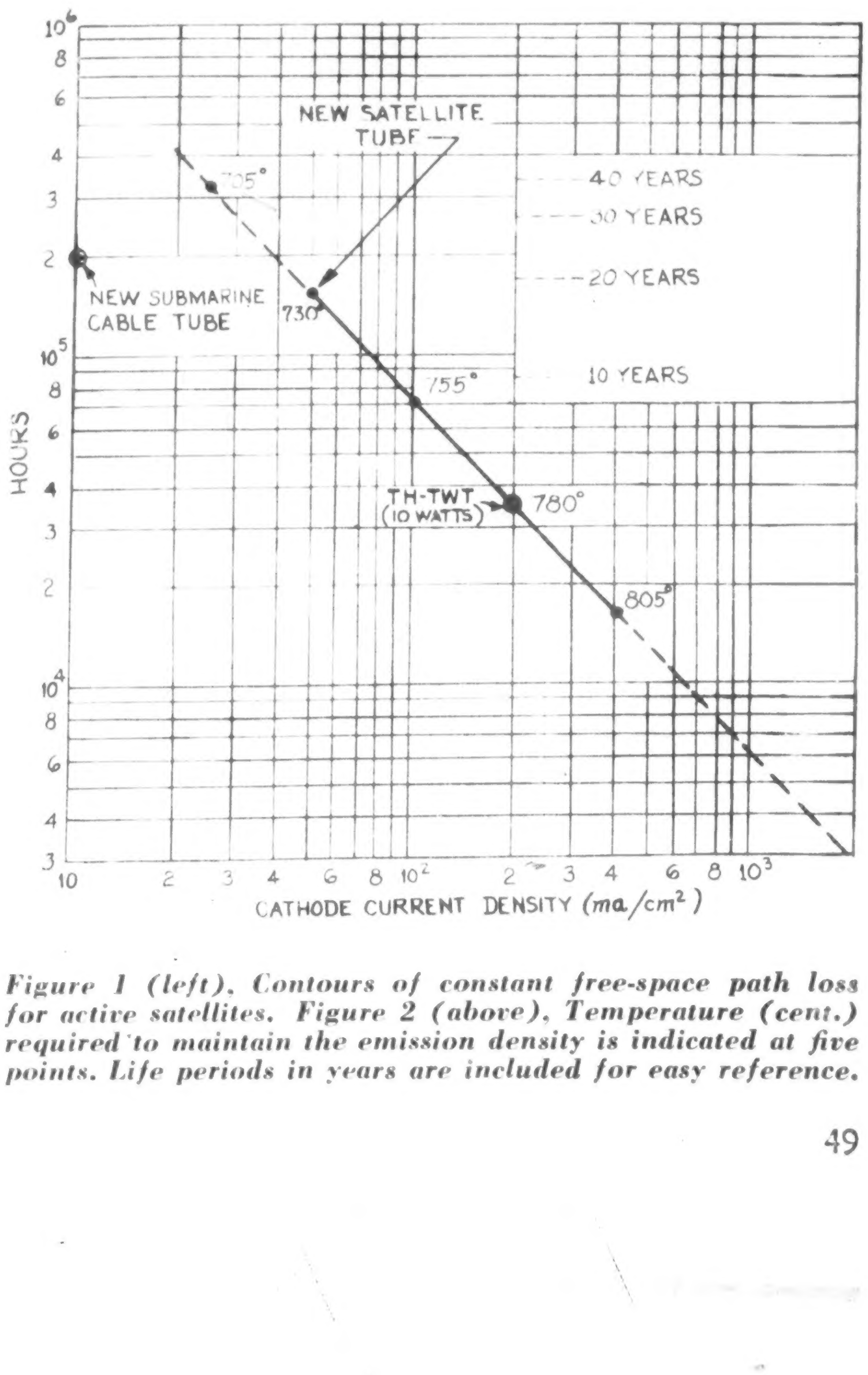


Figure 1 (left). Contours of constant free-space path loss for active satellites. Figure 2 (above). Temperature (cent.) required to maintain the emission density is indicated at five points. Life periods in years are included for easy reference.

pected to give a channel adequate for a TV circuit some 48 db, peak-to-peak noise to RMS signal; and converting this same base-band into message circuits, we expected to get between 500 and 1000 circuits with signal-to-noise performance adequate to meet Bell System long-haul requirements.

I call your attention to the fact again that we are using a broad-band modulation technique. At the moment this is intended to be an FM with feedback system, but one of the cardinal principles in designing the satellite was that it should not be keyed to any particular modulation scheme. This allows us the option of changing the modulation technique without changing all of the electronics in the satellite.

One of the most important problems in developing an active satellite repeater is the matter of life; in order to achieve this, we are going to use first of all low power, as I've already mentioned, and develop a special traveling wave tube for this application. Figure 2 shows the plot of expected cathode life in hours on the ordinate against the cathode current density as given on the abscissa. I don't believe there's a 1-to-1 correspondence between tube power output and cathode current density, but at least there's a correlation. High-powered tubes tend to be on the right-hand part of this curve, low-powered tubes on the left-hand part; note the submarine-cable tube.

We have one good experimental point on this curve: that's the one near the center labelled "TH"—traveling wave tube. This is a 5-watt traveling wave tube at 6000 megacycles developed for the Bell System TH Microwave Radio System. They have had twelve tubes of this design on life test in the laboratory for a period which is now approaching four years, and all twelve of these tubes are still alive. The new satellite tube will be scaled from that one. It is intended to operate at about the same frequency with a cathode current density of some 50 milliamperes per square centimeter as against 200 for the TH tube. This design is also backed up by an extensive research program on cathode fabrication and cathode techniques in Bell Laboratories.

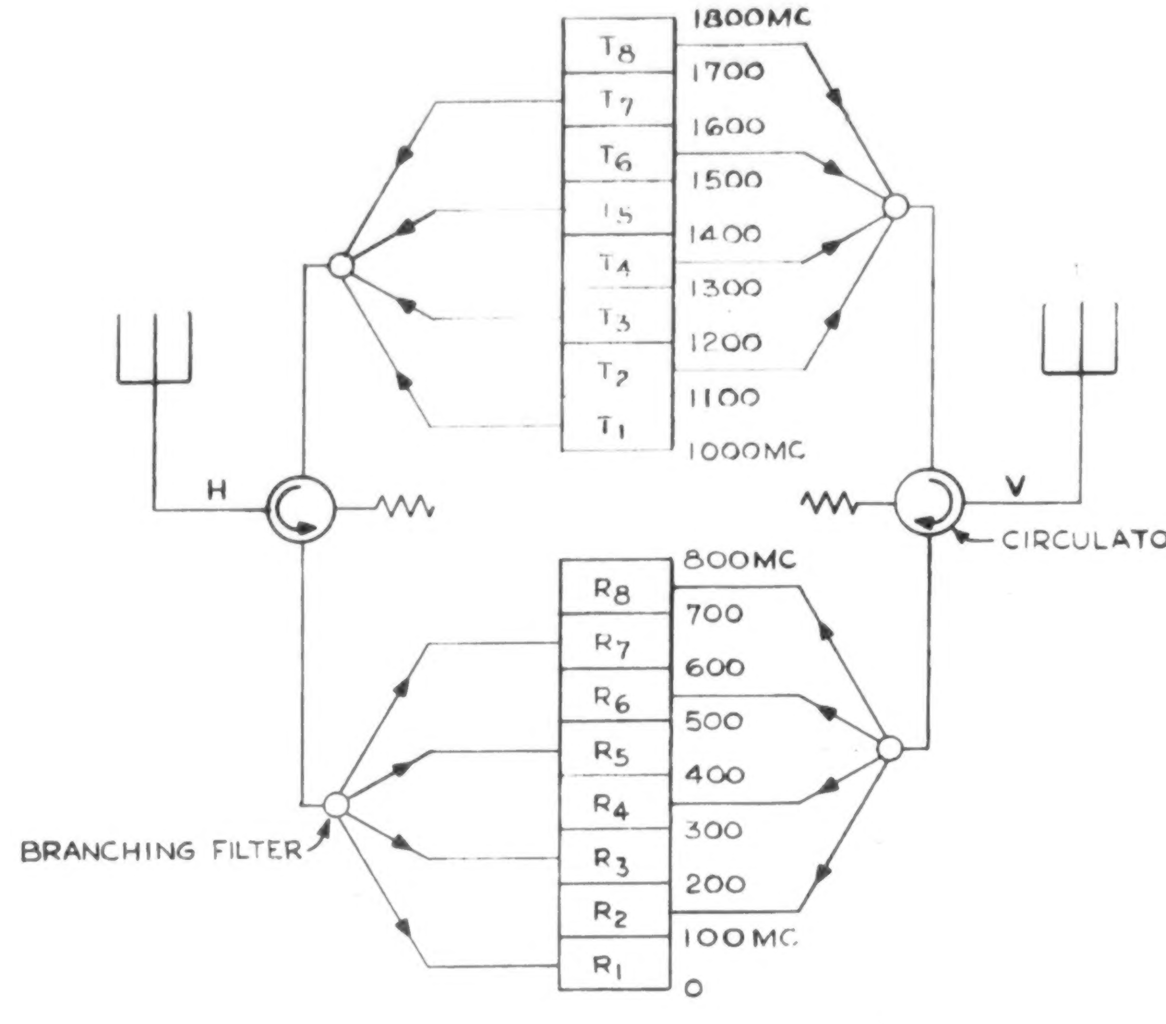
Now we come to the problem of choosing a circuit for the repeaters. As I already mentioned, one of the ground rules we laid down was that the repeaters should be designed so that we could change the modulation technique without redoing all the electronics in the repeater. Another ground rule was that it had to be essentially an amplifier so that when there was no input, there would be no output; it would be undesirable, we think, to have a repeater in orbit which emitted a signal which might interfere with other people's operations, even though it was not at that time being used.

One possibility is a repeater amplifier using all traveling wave tubes. The difficulty with a repeater of this sort is that it involves perhaps too many microwave tubes; in general, it takes about three tubes to get as much gain as we expect to need—and also quite a lot of microwave circuitry. You can avoid some of the microwave tubes if you use the so-called reflex arrangement.

The technique here is to introduce the signal into the first traveling wave tube at a frequency F1, send it through the amplifier and, by suitable filters, introduce it back to the modulator in the center of the picture, change it to frequency F2 and send it back to the gain channel again, convert it to F3, amplify it once more and send it on out. In general, however, we can't get one traveling wave tube to do this entire job, even though we use it over and over; the trouble is that low-noise tubes are also inherently low-power, and unfortunately tubes with adequate power output are always high-noise tubes. So here again we would have to use at least two tubes; and we feel this involves too many microwave tubes.

The preferred arrangement at the moment is a conventional one which is used, for example, in the TD-2 system. The incoming signal is demodulated to an intermediate frequency with a suitable local oscillator system and, using that same oscillator, we beat it back up to microwaves, amplify it to the one-watt level in the traveling wave tube, then send it on out. The intent—and we are actually working on this—is to do all the local oscillator and IF w with solid-state devices. This is mean accomplishment because the system has to be about 100 megacy wide and the local oscillator has operate in the 6 kmc region. The s us of this work is that while we h microwave devices that do these j we need somewhat more power out at 6 kmc.

There is another possible arran ment. It makes use of the very br band inherent in the traveling w tube, and we take advantage of this using the traveling wave tube twi once in the normal way to amplify through signal, and then at the sa time but at a different frequency cause it to "sing" or oscillate and that signal as the local oscillator. T arrangement is also being studied a pursued in part as a back-up for perhaps more difficult solid-state rangement.



NOTES:

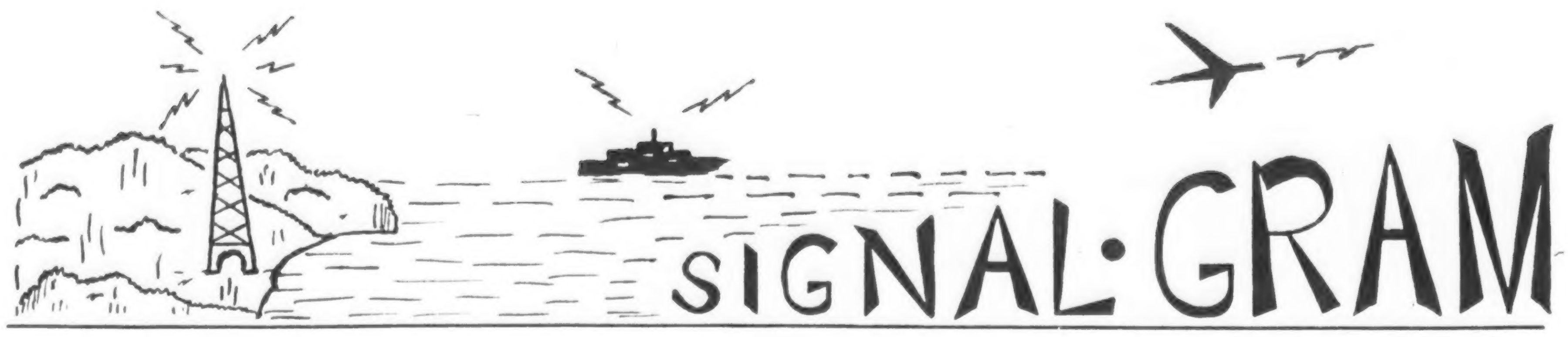
$R_1 \rightarrow T_1$, $R_2 \rightarrow T_2$ ETC. . . . . $R_8 \rightarrow T_8$

ONE SATELLITE PROVIDES:

4 TWO-WAY BROADBAND CHANNELS OR 4000
TWO-WAY VOICE CIRCUITS IN 1800 MC

FIGURE 3

Figure 3 shows the circuit arrang ments and frequency allocation pla for a more elaborate kind of syste with a number of through channe All of the microwave devices here a well within the state of the art. Aft we have achieved a single two-w channel, which is the present plan, can put together a repeater of this s and put it into orbit, contingent on upon having rockets of suitable capaci available to us.



— GOVERNMENT —

SECOND U.S. TEST NAVIGATION SATELLITE and a solar radiation measurement satellite were hurled into orbit June 22 by a single rocket. This is the first time the United States has sent two satellites into orbit simultaneously by using one rocket. The smaller satellite, a 42-pound package containing instruments to measure solar radiation, was clamped to the 223-pound navigation satellite when the two-stage Thor-Able-Star rocket launched the pair. A spring device separated the two payloads once they were in orbit. Transit II-A, the navigation satellite, is an advanced version of Transit I-B, which was hoisted into orbit by the first Thor-Able Star last April. Both are forerunners of an operational network of Transit satellites that can give ships, submarines and airplanes accurate position fixes in any weather, day or night, anywhere in the world. The Pentagon has given priority to the Transit program because of its importance to Polaris missile submarines. By extending a whip antenna above the ocean surface,these subs will be able to obtain a position reading from the nearest Transit. This data will be vital in plotting missile trajectories. The Transit satellites are designed by the Applied Physics Laboratory of Johns Hopkins University. The smaller vehicle was developed by the Naval Research Laboratory.

GIANT NAVY BALLOON gathered data on cosmic rays as it floated over the southwestern portions of the United States early last month. The forty-story high plastic balloon launched from the Naval Air Station, Brunswick, Ga., carried an 800-pound stack of nuclear emulsion which recorded the interaction of ultra high energy cosmic ray particles. After the emulsion is developed, it will require several months of study before cosmic ray experts will be able to evaluate the results of the experiment.

AIR FORCE-WIDE STUDY OF TECHNICAL PUBLICATIONS will determine ways and means of reducing costs in this field. Established on instructions from Headquarters, U. S. Air Force, the study group will decide whether some Air Force technical publications, although needed and utilized, may be too costly to prepare. If this is the case, future publications of this type would be published on a reduced-cost basis. The group is to finish its study by September 1.

U. S. LAUNCH VEHICLE PROGRAM calls for the use of a "minimum variety" of standardized vehicles, according to Major General Don R. Ostrander, USAF, Director, Launch Vehicle Programs, National Aeronautics and Space Administration. Addressing the Semi-Annual Meeting of the American Rocket Society in Los Angeles recently, General Ostrander said, "The nation cannot, and fortunately need not, afford two major vehicles, one NASA, one military, with approximately the same capability." NASA is conducting cooperative programs with the military on the SCOUT, the AGENA B and the CENTAUR launch vehicles. The VEGA launch vehicle program was cancelled in favor of the AGENA B, General Ostrander continued, because the AGENA B "was a little ahead, time-wise, and could do the same job, plus the fact that with a cooperative program we would get more total firings and consequently more reliability."

REVIEW OF DYNA SOAR DEVELOPMENT PROGRAM has been completed and DYNA SOAR contractors will now begin the design and ground testing necessary to build a boost-glide aerospace test vehicle, according to the Air Force. The review determined that there is sufficient technical data available in critical areas of aerodynamics, structures and materials to permit actual design of the DYNA SOAR glider immediately. In support of this decision the Air Force has now released 1959 and 1960 fiscal year funds totaling $29.7 million for the project. The Air Force FY 1961 budget contains an additional $58 million for support of the program. To date, $3.5 million has been expended on the program. DYNA SOAR is a rocket boosted hypersonic glider.

ADDED FUNDS FOR NIKE ZEUS anti-missile missile system have been made available and will be used to expedite research and development work on the Army missile system, according to Secretary of the Army Wilbur M. Brucker. The $18 million, which the Army had saved this fiscal year in other areas, will be used for the development of "Zeus components which require an extreme degree of reliability and ultimately will be required in large quantities."

NSF UNDERGRADUATE SCIENTIFIC RESEARCH PROGRAMS will enable 2500 students to work with scientists of more than 200 research organizations this summer and during the coming school year. The research will be supported by 330 grants totaling $1.8 million as part of the National Science Foundation's Undergraduate Research Participation and Undergraduate Research Training programs. Both programs are designed to build interest of superior students in scientific research in the physical, biological and social sciences.

IMPROVED INERTIAL NAVIGATION SYSTEMS will be installed on the Polaris submarines SAM HOUSTON and JOHN MARSHALL, according to the Navy Department. Called "Gyro Navigators" by their manufacturer, Sperry Gyroscope Co., the inertial systems will give the two submarines the navigational information needed to launch missiles underseas. The newest developments in the Gyro navigator include the use of the first interchangeable gyros and an improved and integrated polar mode of operation that will allow the submarines to operate under the ice with even greater facility, the Navy said.

ARMY POLAR RESEARCH TEAM is exploring the Greenland Ice Cap in an effort to develop techniques for transportation support operations in difficult environments. Scientists accompanying the 30-man task force will make meteorological, glacial and other scientific observations. An interesting item being used on the expedition is a weasel equipped with an electronic crevasse detector. The animal will be used to explore any feasible routes to the sea which are pinpointed by air reconnaissance.

CONTRACTS: ARMY: Motorola, Inc., production of 12 radio central switching systems, $10.9 million; Western Electric Co., Inc., research and development on the Nike Zeus missile system, $4 million; General Instrument Corp., production of radio sets, antennas and antenna accessories, $1.9 million. NAVY: Bendix Corp., continued development and evaluation of the Eagle missile system, $21 million; Sperry Rand Corp., design and manufacture of navigation subsystem equipment for 9 Polaris firing submarines and two submarine tenders, $8.8 million. AIR FORCE: Collins Radio Co., production of components of AN/ARC-58 radio system, training parts and data, $1 million.

— INDUSTRY —

ELECTRO-OPTICAL SYSTEMS, INC., has developed and manufactured a new high-speed camera which is being used by Army scientists in their study of explosive materials. To find ways of making explosive materials more reliable and more useful for military and civilian applications, scientists need better knowledge about what happens during detonations. The new camera is helping uncover this kind of information. Possessing an exposure speed of one five-billionth of a second, the camera has made still photographs of explosion shock waves traveling as fast as five miles a second.

AMERICAN MACHINE & FOUNDRY Co. will design and develop an underground launching system for the Atlas intercontinental ballistic missile. The system will be capable of withstanding severe shock, such as a nearby nuclear blast, according to AMF officials. The company also is working on similar systems for the Titan ICBM.

MINNEAPOLIS-HONEYWELL REGULATOR CO. will develop and build a nuclear submarine training center which will electronically simulate full-scale naval battles. Under a $3.6 million contract from the Naval Training Device Center, Minneapolis-Honeywell's Ordnance Div. will provide the new center with advanced electronic techniques enabling the center to wage realistic mock sea battles. Located at the Navy's Submarine School in New London, Connecticut, the center will be used for training crews of Polaris-armed submarines in modern underseas warfare tactics.

BELL AIRCRAFT CORP. will develop an electronic airplane landing system which will help provide all-weather operational capability for the Navy's task forces. Under an initial $4.3 million contract from the Navy, Bell Aircraft's Avionics Div. will provide four complete AN/SPN-10 systems, three for installation aboard aircraft carriers and another for pilot familiarization at a land base. Delivery is scheduled to begin in eighteen months. Each system consists of two radar antennas mounted on the carrier's superstructure to track an incoming airplane, two visual displays which provide precise data about the location of the airplane with respect to the carrier deck and electronic computers which determine whether the plane is on the proper descent course.

(Continued on page 54

WESTINGHOUSE ELECTRIC CORP. will provide long range shipboard radio communications equipment to the Navy under a $12 million contract awarded to the firm's Electronics Div. AN/WRT-1 and AN/WRT-2 transmitters will be delivered late this year to the Navy with production scheduled to continue into 1962. Simplicity of design and a high degree of stability for shipboard service have made these systems an optimum choice for fleet and submarine installation,according to the Navy.

— GENERAL —

FM STEREO RADIO TESTS are being conducted by the Electronic Industries Association at the request of the Federal Communications Commission. The tests are being supervised by the National Stereophonic Radio Committee, established by EIA, and will constitute the committee's first official field experiments with stereo radio on behalf of broadcasters and equipment manufacturers. Two Boson stations and one Pittsburgh station are being used for the field tests. Test results will be submitted to the FCC which plans to establish transmission standards for FM stereo broadcasting.

RADIO TELESCOPE specially designed to pick up faint scources outside our own Milky Way galaxy will go into operation early in the fall near Danville, Illinois. Its primary mission will be to make detailed maps of the universe which will include celestial objects previously undetected and far beyond the range of the largest optical telescope. The first project will be to make a detailed map of the sky at the frequency of 611 megacycles, because scientists believe that this frequency includes the largest number of radio sources in space. The University of Illinois is responsibile for the construction and operation of the massive installation, 600 feet long, 400 feet wide and 62½ feet deep, under the sponsorship of the ONR.

WORLD ASTRONAUTIC UNIT will be formed next month to provide technical leadership for the peaceful exploration of space,according to a joint announcement made by the International Astronautical Federation and the Daniel and Florence Guggenheim Foundation. According to present plans, the International Academy of Astronauts will be established at the August meeting in Stockholm of the International Astronautical Federation. The Guggenheim Foundation has made a grant of $75,000 for the operation of the Academy during its first three years. The chairman of the academy's founding committee is the American astronautical scientist, Dr. Theodore von Karman.

FLORIDA DIRECTORY lists 313 establishments whose major activity is manufacturing, testing and research in electronics, aircraft, missile,scientific instruments or nucleonics. Issued by the Industrial Services Division of the Florida Development Commission in Tallahassee, the directory contains a listing of companies by city and also an alphabetical listing by company name. Copies are available on request.

TWO ENGINEERING WRITING GROUPS may join forces and form a new organization which "would be in a better position to help in industrial writing improvement efforts," according to a spokesman for one of the groups. Located in Pasadena, California, the groups involved are the Technical Writing Improvement Society (TWIS) and the Western Technical Writing Institute (WTWI). TWIS is a national society of educators, trade journal editors, engineering directors, technical editors and other industrial personnel. WTWI is a resident school and research organization in industrial writing techniques. Discussions on the proposed merger were held in May.

CAL TECH TWIN RADIO TELESCOPES were used to detect a radiation belt around the planet Jupiter. Believed to be 100 trillion times stronger that that surrounding the earth, the belt is located about 200,000 miles above the surface of the planet. The two 90-foot telescopes detected the radio waves emitted by high speed electrons trapped in Jupiter's magnetic field. Sponsored by the Office of Naval Research, the project was conducted at the California Institute of Technology. The existence of the belt makes it unlikely that man will ever be able to approach closer to Jupiter than perhaps to one of its moons, some of which are more than a million miles from the planet.

CALENDAR OF EVENTS

JULY 26-31: Photographers Association of America meeting, Los Angeles, Cal.

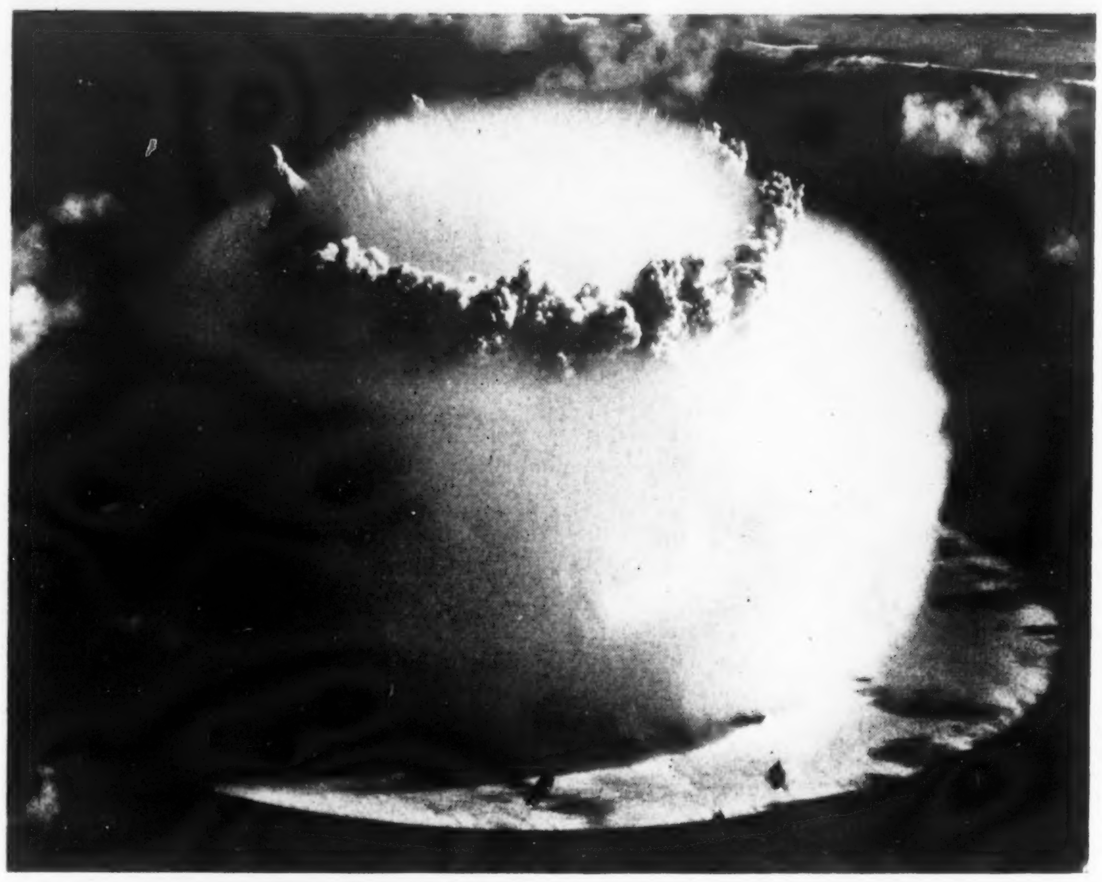
JULY 26-AUGUST 7: Missile and Rocket Institute meeting, University of Connecticut, Storrs, Conn.

AUGUST 1-3: The 4th Annual Global Communications Symposium, sponsored by Institute of Radio Engineers and U. S. Army Signal Corps, Statler Hilton Hotel, Washington, D. C. (See page 16 for details.)

AUGUST 6-9: National Audio-Visual Association Convention and Exhibit, Morrison Hotel, Chicago, Illinois.

AUGUST 7-12: The 69th Annual Exposition of Professional Photography and the 8th National Industrial Photographic Conference held concurrently at the Conrad Hilton Hotel, Chicago, Illinois.

usaf bomb alarm system



by MAJOR ROBERT W. EWELL, USAF
Plans & Requirements Branch, Directorate of Communications/Electronics, Hdq. USAF

A RED LIGHT GLOWS ON A DISPLAY BOARD, a bell sounds in a Fire Warning Control Center alerting the Fire Department that a fire has broken out in a huge munitions plant. They are on the way.

A red light glows on a display board, a bell sounds in an underground command post alerting the United States that a nuclear weapon has been detonated over a key target area. Nuclear retaliation is on the way. Simultaneously, a similar display is observed in the Office of Civil and Defense Mobilization. By applying current weather information to the blast area, nuclear fall-out prediction is made and the local authorities in the endangered zones are immediately alerted to move the populace to a safe location. Rescue and medical teams are mobilized and dispatched.

Both of these systems are "warning systems" in the sense that they have warned that something *has* happened. Immediate action to counter the threat is required. They are not warning systems in the same sense as the Ballistic Missile Early Warning System (BMEWS) or the Distant Early Warning (DEW) Line, which indicates beforehand that an attack *is about* to happen.

One of the basic tenets of our national philosophy and policy requires these warning systems. We are not, nor will we ever be, an aggressor. Our nation's leaders must be positive that an actual attack has occurred before taking retaliatory measures. Every precaution is essential; a meteoric shower, or other natural phenomena, must not trigger World War III.

Positive information, even after the first wave of an attack, could well provide the key to survival. Those of us who remember the confusion incident to December 7, 1941, will recall the rumors received on the East Coast that Los Angeles and San Francisco were under attack and that enemy troops were landing on the California coast. Overloaded communications facilities prevented immediate confirmation or denial of these rumors. Similar confusion which might result from a nuclear attack launched, for example, by enemy submarines could result in a disastrous loss of time in launching our retaliatory forces. Bombers on air bases and missiles on launch pads are prime, highly vulnerable, targets. Every second counts in assuring their survival.

As one counter to such a condition, the Air Force has contracted for a Bomb Alarm System, developed as a team effort by the Western Union Telegraph Company, Air Research and Development Command, Strategic Air Command and Headquarters, United States Air Force. This system will provide selected key civilian and military leaders with a positive means for identifying nuclear or thermonuclear detonations in the vicinity of over 100 key target areas.

The heart of our Bomb Alarm System consists of a relatively simple and rugged detector, or sensor, manufactured by Watermill Laboratories of the Western Union Telegraph Company. Its design was predicated on the fact that a nuclear detonation has a characteristic signature which emits thermal radiation in two pulses. Since this device is responsive to the visible portion of the thermal spectrum which precedes the shock wave, it permits the transmission of warning that a nuclear blast has occurred before the sensor itself receives any damage. At a distance of one mile from a one megaton blast, the thermal radiation arrives about four seconds ahead of the shock wave. As a further precaution, the sensors will be arranged approximately equidistant around a target and have a minimum of three sensors per target area. Thus, even if one of the sensors should be at a "ground zero" point, the other two sensors would react to the detonation.

The sensor is housed in a heavy, air-tight, aluminum cylindrical container, about 9 inches in diameter and one foot high, which is surmounted by a cylindrical Fresnel type marine lens. Within the lens is a cylindrical perforated metal shield, which has an attenuation factor of 100 times, and, inside the shield, three photo cells are mounted at the focus of the lens.

The photo cells are of the silicon "sun battery" type. Three cells, each 1 by 2 centimeters, are mounted in a triangular structure with the sensitive surface on the outer face, thus providing a 360 degree coverage. Any light striking these silicon cells causes a voltage change in the associated circuitry since they are of the photo-voltaic type. However, unless this light has a specific waveform it will not trigger this warning signal.

A discriminating circuit applies a series of tests to each light pulse. Each must be satisfied in turn before the next test is made. A blast is reported only when all the tests are passed. An amplifier provides voltage to three circuits of a discriminator, one differentiating and two integrating. The first input is differentiated and applied to trigger a monostable multivibrator. This multivibrator operates only if the pulse is of suffi-

(*Continued on page 72*)

by **EARL D. ANDERSON, Project Supervisor, Maintenance & Operations, Western Union Telegraph Co.**

facsimile telegraph network for weather map

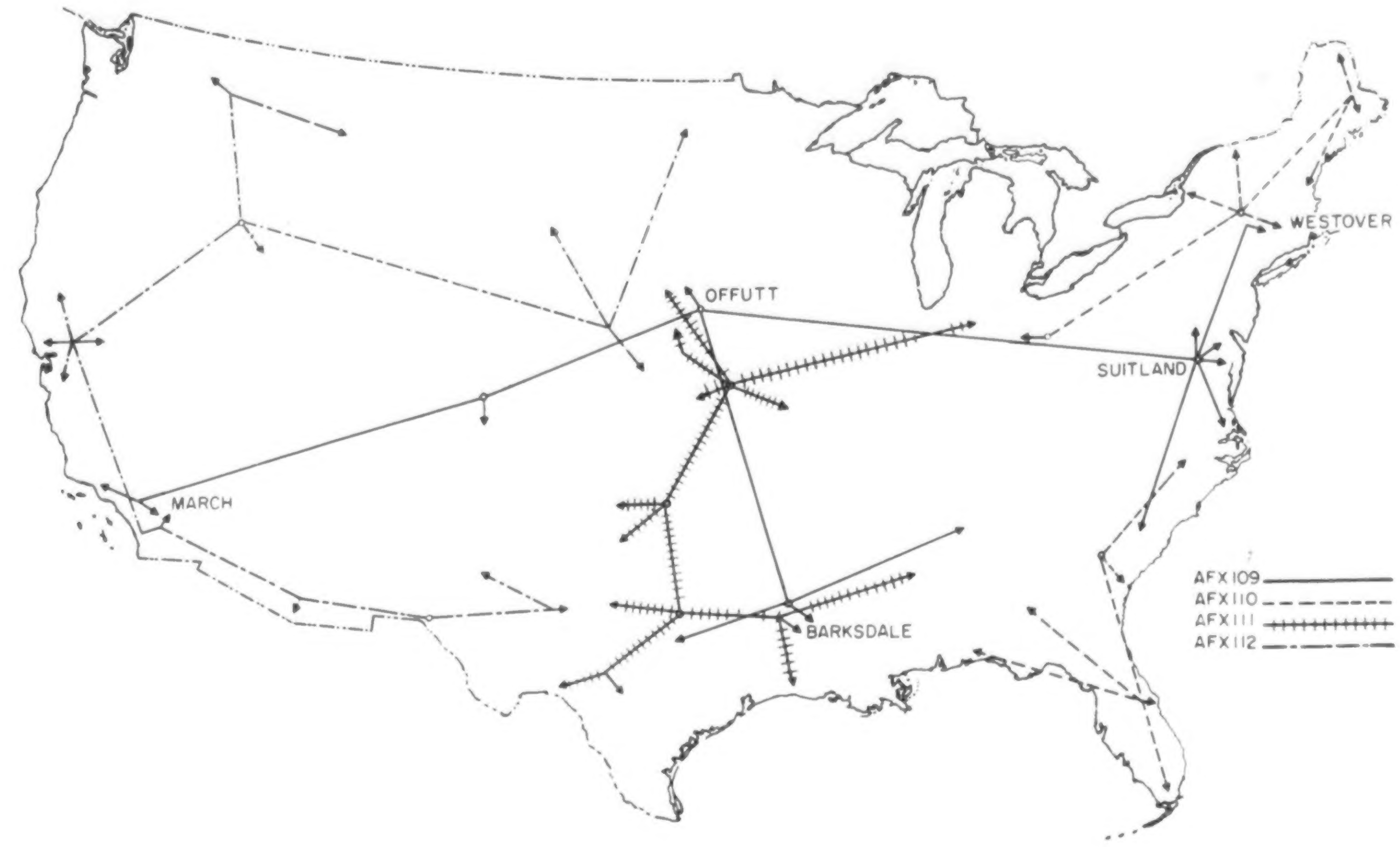


Figure 1. Strategic Weather Facsimile Network for the AACS

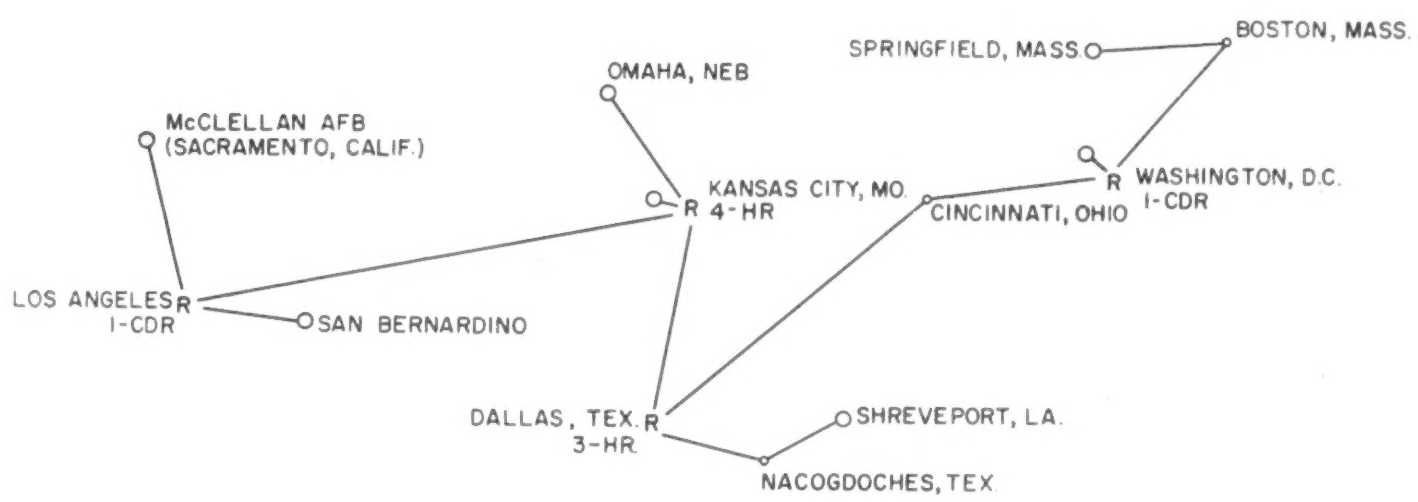


Figure 2. Teleprinter Talk Channel TC-20

An extensive new facsimile telegraph weather map network has been provided by Western Union for the U.S. Air Force Strategic Air Command. This system for rapid transmission of weather charts links some 60 stations of the USAF Air Weather Service at Air Force bases throughout the United States and makes possible a continuous flow of up-to-the-minute weather maps to air operation centers of the Strategic Air Command.

Known as the Strategic Facsimile Network, the nationwide telegraph system is leased from Western Union by the Airways and Air Communications Service (AACS) and is operated by Air Force personnel. Both AACS and Air Weather Service are technical services of MATS, the Military Air Transport Service.

Center of the network is the Global Weather Central at Offutt Air Force Base, Omaha, Neb. Other transmitting stations are at the National W
ther Analysis Center, Suitland, M
and at strategically located weat
centers at Barksdale AFB, Shrevep
La.; March AFB, Riverside, Cal
and Westover AFB, Chicopee Fa
Mass. As indicated in Figure 1, e
transmitter serves chart recorders i
wide area with international, natio
and local weather information incl
ing high altitude data.

Control of the main transcontiner

circuit, designated AFX109, rests at Offutt AFB where a manual switch allows transmission by Suitland, Barksdale, March, Westover or Offutt. Switches at these centers except Suitland provide for transmission over territorial networks, designated AFX110 out of Westover, AFX111 out of Barksdale, and AFX112 out of March AFB, or for transmission and simultaneous recording from the transcontinental circuit.

Important considerations which required attention both prior to and after installation of the network are:

1. Completely new equipment scattered throughout the country required training of maintenance personnel.
2. Delay and amplitude corrected facilities, their installation and maintenance.
3. Special test equipment to allow the testing of recorders at all receiving-only drops.
4. Adequate communication facilities between all points for the coordination of testing prior to the installation and for maintaining circuit continuity.
5. Equipment design: does it allow for easy maintenance and what will be required in connection with trouble shooting?

Training Program

First and greatest problem to be solved was the training of maintenance personnel on this new equipment. Two instructors, one from the Chattanooga Training Center and one from the Field, three engineers from General Headquarters Plant Department, and one from Research and Engineering, attended a two weeks' school at the Westrex Corporation (formerly Times Facsimile) plant in New York. A training school was then established at the Chattanooga Training Center.

Installation of the network was scheduled in four phases, each phase separated by one month. Phase one was the installation of AFX109 on February 15, followed by 110 on March 15, 111 on April 15, and 112 on May 15. This schedule allowed maintenance personnel to be trained on the same basis. Three classes were scheduled: A Basic Electronics Class, Recorder Class and a Transmitter Class. Each of these was scheduled for one week and ran sequentially thus allowing a maintainer to attend the classes considered necessary for his job. In addition to training the regular and alternate maintainers, an engineer or supervisor and their alternates from each Area involved were also trained. Except for holiday periods, these classes ran continuously from December 1 through May 15. Over 200 engineers, supervisors and maintainers were trained during this period. Thus with the start of installation in February, the current trainees were returning to their job locations and installing the equipment with their training fresh.

The second problem was the delay and amplitude equalizing equipment. The Plans and Methods section devised their own training and installation program preceding the equipment installation by one month wherever possible. The problem remaining was how to maintain these facilities, especially since many of them did not go through Western Union offices.

Circuit Check-up

The Air Force allowed one half hour each day beginning at 12 noon to be used for a circuit lineup period. At noon every day WQ (Washington, D. C.) places a 2400-cps tone at zero dbm on the network. This is read by all wire chiefs, who have access to the facilities. The tone is checked for proper level. At 12:15 WQ places a 600-ohm termination on the network and all wire chiefs check for noise. Any deviations from standard levels are immediately reported and action taken to have the fault corrected. At 12:25 the network is restored to normal and traffic is resumed at 12:30.

With the exception of the five transmitting stations all others have only recorders and a means had to be provided to test a recorder in the event of a failure. The manufacturer developed a small portable transistorized test generator for this purpose. When properly connected to the recorder, it allows the maintainer to check the operating sequence and make adjustments. In addition, it produces a bar pattern which can be copied and used to check the copy for jitter and grouping. The supplier also developed two gauges to be used for the styluses and belts. The first is a stylus sight gauge which is used to check the tungsten stylus in its holder for alignment. By inserting the stylus into the sight gauge it can be checked for alignment and straightened if necessary. The second gauge is a belt alignment jig which allows the belt to be clamped in it, and the stylus mounting assembly and holder to be properly positioned. By use of these gauges, running tests and possible refinements, virtually all jitter and grouping may be eliminated from the copy. The run mechanism has a dynamically balanced flywheel which removes nearly all the jitter due to gear mesh in the system.

It was realized initially, that, since many locations were some distance from central points, a communication facility of some type would be necessary to allow initial lineup testing and clearing of facility troubles. As a result TC-20 (Figure 2) was set up for this purpose. Since the facsimile system was undirectional it could not be depended upon for communications. This teleprinter "talk" circuit considerably reduced initial testing and lineup time and has been continually helpful in the daily lineup for level comparisons and failures.

Maintenance Aids

The picture would not be complete without discussing some of the maintenance features which have been included in the design. It requires the loosening of only two large knurled screws to open the cover and expose the complete unit. Taking the electronic section first, all tubes are held in place by clamps. All electrolytic condensors are of the plug-in type and are also clamped. All relays, also of plug-in design, are covered to protect against dust and held in by clamps. The dust cover may be removed readily by removing two screws for inspection of the contacts. The bottom of the electronic chassis may be exposed by removing the front two cover plates each of which is fastened with four screw turnout locks. With the exception of one or two small components all are board mounted. Each component has its own designation stenciled on the board directly under it and the designation is the same as the number on the wiring or schematic drawings. All tubes and relay sockets also are clearly stenciled on the chassis for ready identification. All voltage and resistance measurements at all tube and relay socket pins are furnished in the specification. In addition photographs of typical copy with common faults, and their correction, and a complete trouble shooting guide are included.

The mechanical mechanism also is readily removable. A single locking Cannon connector carries all the electrical circuits required. It is necessary only to unlock this, loosen the band screw which separates the exhaust blower unit, and remove the four mounting screws leaving the unit free to be taken out of the housing. In addition, an adapter cord is provided so that the mech unit may be run on the bench away from the housing. A small vacuum cleaner attachment is furnished which when attached very simply to the exhaust blower system allows for the removal of loose soot accumulations. The activated charcoal and glass wool filter in the canister may be replaced on the job by the maintainer.

Transmitter Design

The transmitter was designed on a comparable basis, and certainly maintenance was kept in mind. The electronic chassis is separated from the mechanical unit in the housing and is readily accessible. The top cover of the housing is lifted up, the two large knurled screws are loosened by hand, and the chassis may be swung up to permit access to the bottom. Again all components are clearly stenciled and board mounted. All relays are of the plug-in type with the exception of one delay relay in the auto loading circuit. All standard relays are of the plug-in type and all are interchangeable. The delay tube, which is plug-in, and the delay relay are not interchangeable but are readily accessible.

All electrolytic condensers are of the plug-in type and all tubes, electrolytic condensers and relays are held in posi-

tion by clamps. All relays are enclosed in plastic dust covers which may be removed for close inspection of the contacts. Again, as in the case of the recorder, all voltage and resistance measurements at all relay and tube sockets are given in the specifications. In addition, various waveforms with peak-to-peak readings are given at all critical points. The transmitting points were furnished Hickock 685 LP oscilloscopes with calibration circuits so these tests could be made. In addition, vacuum tube voltmeters were furnished for those voltage readings in sensitive circuits. The electronic unit is connected to the mechanical chassis by two cables both equipped with screw type Cannon connectors.

The mechanical units may be slid out of the housing. The bottom unit is on slides which hold it in an extended position. The top unit may be worked on by swinging open the top cover and swinging up the electronic chassis or sliding it out and resting it on top of the bottom unit. The exciter lamp is readily accessible by moving one knurled screw; however, it is a soldered connection. The one adjustment is to focus the periscope lens system which is done by placing a scope in the proper test point and turning the lens in or out until maximum signal is observed on the scope. The only other adjustment to be made on the carriage assembly is on the half nut which engages the lead screw.

Each recorder location has a working recorder on the circuit plus a working spare recorder which may be connected to the circuit by a Type 6017-E key. In addition, a maintenance spare is used to back these two working units. The transmitters at all locations are of the dual type. At Suitland and Offutt Air Force Bases, there are additional dual units which also may be placed on the circuit by means of a Type 6017-E key. At March, Barksdale and Westover Air Force Bases there are dual transmitter units in service and single transmitters for maintenance spares.

Equipment Description

Equipment used on this network was developed and manufactured for Western Union by the Westrex Corporation in New York City. The transmitter was so designed as to be compatible with most facsimile equipment used in this type service. It is a drum type unit and will handle copy up to 18 by 36 inches. A mylar wrapper and automatic clamping arrangement are used to hold the copy on the drum. The drum speed is 120 rpm utilizing a carrier frequency of 2400 cps. The carriage is positioned electrically by a small reversible motor and belt connected to the scanning head.

The dual type working transmitters are electrically interconnected so that both drums may be loaded and both transmitters started. However, one transmitter will send its copy to the line, shut off, and the second transmitter will automatically wait ten seconds and then begin its transmission. This allows the recorders to complete their stop cycle and ready themselves for the next transmission. A switch on the front panel allows the operator to move the scanning head either left or right. Although this speed and carrier may be changed by a switch mounted on the front panel of the electronic chassis, the switch has been fixed at the 120-rpm setting on the units used on this network. Listed below are the speed settings and associated carrier frequencies:

60 rpm	1800 cps
90 rpm	2400 cps
120 rpm	2400 cps

Scanning

The copy scanning head consists of an exciter lamp, an elipsoidal mirror which focuses the light on the copy, a periscope-mounted lens arrangement, phototube, half-nut assembly, and the first tube in the cascode amplifier section. In the center of this elipsoidal mirror is the periscope arrangement which carries the reflected light to a two-plate phototube. With this arrangement there is no angle of incidence or reflection to contend with from the mylar wrapper.

The phototube is an RCA Type 5652 which was developed by the supplier and is used in a bridge circuit to form a phototube balanced modulator. The carrier oscillator, oscillating at 2400 cps, is connected to one plate. When light shines on the two plates, the resistance between them is lowered and the tube conducts. The signal is then passed to a cascode amplifier which is a low-noise type amplifier. Since more light is reflected from white, the maximum signal is white, minimum, black.

After being amplified in the cascode amplifier the signal is passed to a gain-controlled 6386 tube. Since the signal at this point is white maximum, the ALC circuit attempts to maintain this voltage and not the lower black voltage. As a result, some automatic contrast is obtained. That is, it attempts to maintain the voltage ratio between black and white signal. The signal is now taken from the plate of the second half of the 6386 tube and impressed on a 100K resistor. At this same point, the carrier frequency of 2400 cps is arriving but it has been passed through a phase shifting control and an amplification stage such that its amplitude is equal to the white signal, but 180 degrees out of phase, and cancellation occurs. Thus, at this point inversion takes place and black copy now produces maximum signal. This is now passed through the vestigial filter which removes the upper sideband leaving the lower sideband which is amplified and passed to the line.

Contained also in this unit is a 450 and 300 cps oscillator and a transformer. The latter allows either 300 cps, 450 cps or 60 cps to be coupled to the 100K resistor instead of copy signal. A diode arrangement causes these signals to modulate the 2400 cps coming from the carrier oscillator. The appliction of these tones and the copy signal along with phasing pulses is controlled by six cams driven by small motor and this forms the program timer. The sequence is as listed below:

450 cps (stop tone)	5 seconds
300 cps (start tone)	5 seconds
2400 with phasing pulse	15 seconds
60 cps (start tone)	2 seconds
Fax copy	30 minutes
450 cps (stop tone)	5 seconds

The phasing pulse is obtained from a disk mounted on the end of the shaft. Figure 3 shows the disk, contacts, and the signal produced. The first open is the phasing pulse, the close is the key-

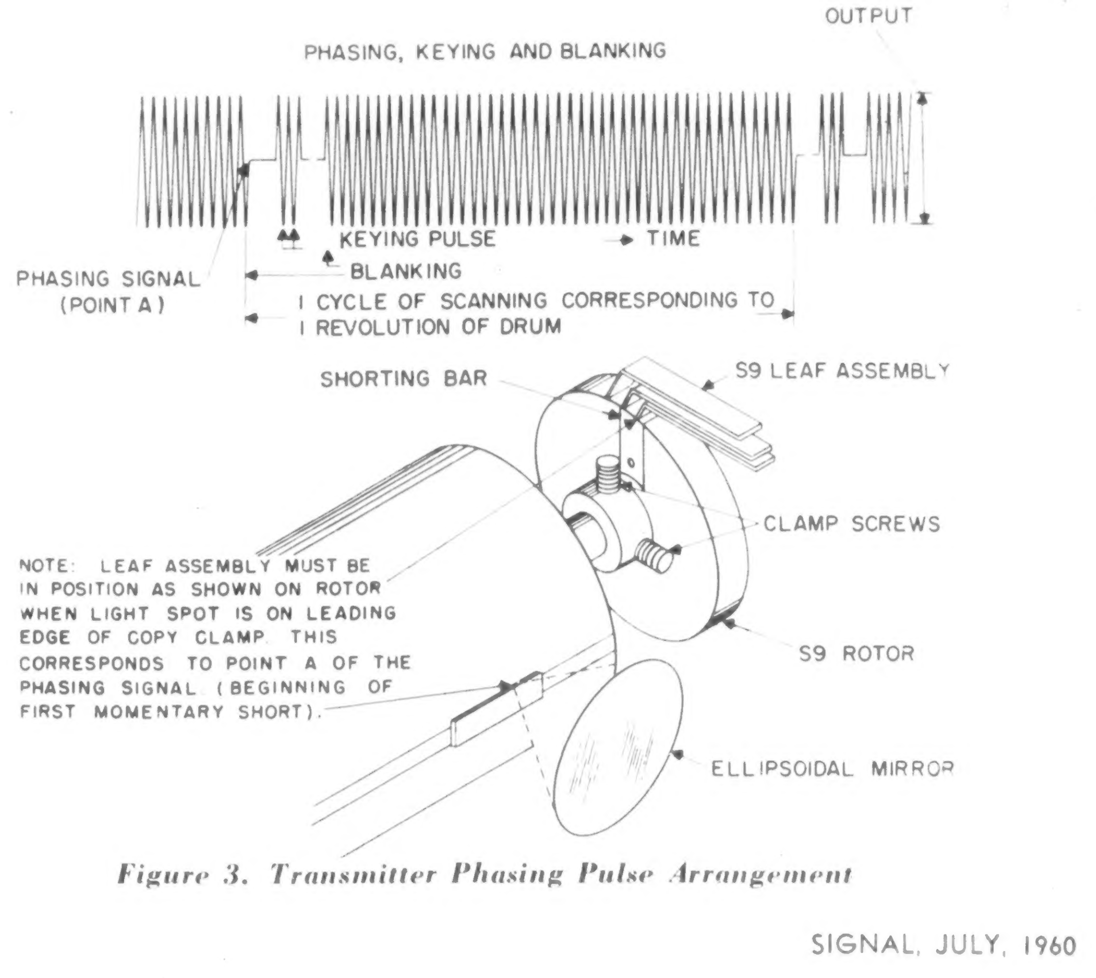


Figure 3. Transmitter Phasing Pulse Arrangement

ing pulse, and the last open is the blanking pulse. The only signal required by the RJ-3 Recorders used on this network is the phasing pulse and copy signal. The other signal tones were specified so that other American and foreign recorders could be used on this network. How these are used at the recorder will be described later.

Synchronization

The synchronous drive system consists of a tuned fork operating in a thermostatically controlled oven oscillating at 1800 cps. The fork oscillator consists of a two-stage triode amplifier, and a peak limiting 606C diode which removes amplitude variations. The fork accuracy is approximately three parts in ten million. This very stable 1800-cps tone is fed to a frequency doubler whose output delivers 3600 cps which is then fed to a frequency divider controlled by the front panel switch as described previously. The divider produces three frequencies for the three drum speeds as listed below:

60 rpm	600 cps
90 rpm	900 cps
120 rpm	1200 cps

This signal is then amplified and passed through a push-pull stage to the synchronous motor winding. The direct current for the plate supply of the push-pull stage is fed through the motor winding and acts to polarize the magnetic field. There is only one pulse per cycle delivered to the motor. However, there are two phases because of the push-pull stage. One-half of the winding is connected to one portion of the push-pull stage and the other to the second part.

The rotor of this synchronous motor is built up of laminations and is approximately $2\frac{1}{8}$ inches in diameter and $\frac{3}{8}$ inch thick. Its periphery has 60 teeth cut in it and the spacing between these and the stator is 0.0015 inch. There is no winding in this rotor. The phase one and two stator coils are so located that when the rotor teeth match up with phase one stator teeth, the phase two stator teeth are half-way between the rotor teeth. Since the phase two stator teeth receive pulses which are 180 degrees out of phase with phase one stator teeth, the rotor receives two magnetic pulses per cycle but advances only one tooth. The motor speed is directly proportional to the applied frequency.

The synchronous motor is mechanically coupled to an arm on the drum shaft via reduction gearing. The drum is rotated by a run motor which is belt coupled to the drum shaft and rotates it at a speed slightly higher than synchronous. The arm coupled to the synchronous motor bears against a stop on the drum holding the drum at synchronous speed.

Recording

The recorder uses "Timefax," a dry recording paper $19\frac{1}{8}$ inches wide and in 350-foot rolls. A density control, for the operator's use, operates over a 5-db range and is mounted on a panel in the front of the recorder. The recorder uses two 6BA6 tubes RC coupled and a 12AT7 in an ALC loop as its initial amplification stages. The ALC loop develops approximately 30 db range. The output of signal to the stylus is via a conventional 6V6 push-pull stage.

The recorder requires only the presence of 2400 cps which is the carrier used in this system to begin its recording cycle. A take-off is taken just prior to the 6V6 output stage. The carrier signal passes through a diode limiter which maintains a constant amplitude of both peaks to a tuned circuit which rejects all signals other than the 2400 cps. The signal is then amplified and passed by a biased 620C silicon diode which removes the positive portion of the signal. This develops a negative bias on the grid of the next stage, overcoming the positive bias, cutting the tube off, and causing the relays in its plate circuit to release. This conditions the recorder for starting. The grid of this stage also has a large condenser attached so that when a modulated white signal is received the condenser will store enough negative potential to keep the tube cut off and the recorder running. The recorder will continue to run on signal and will stop when signal is removed.

When the CXR detector relay releases, contacts on it open removing current to the phase actuator and stop the synchronous drive mechanism. The phasing pulse as previously described is the 2400-cps tone interrupted once every revolution of the drum. A tap is taken at the screen grids of the 6V6 push-pull output stage passing the phasing signal through a filtering network which removes the carrier frequency to a 2D21 Thyratron tube. The pulse causes the grid to have a higher potential than the cathode and the tube conducts. The pulse is used to operate a phase actuator which positions the synchronous drive system.

At this point the recorder has been conditioned for starting and phased; however, the stylus belt is not yet rotating. When the CXR detector relay operated, it closed a set of contacts which conditioned the start tube. As soon as copy signal appears the average voltage of the black and white signals drops. The grid becomes sufficiently negative to cut the tube off releasing Relay K2 in its plate circuit and the stylus belt rotates.

Synchronism is obtained much the same as in the transmitter, previously described. The fork is not in an oven; however, its accuracy is approximately three parts per million. The gears must be changed in the recorder to accomplish speed change. In addition to this a strap on the tuned circuit of the carrier detector must be changed to accept the new carrier frequency.

These then are some of the features of the transmitter and recorder, which are different from facsimile units previously used by this company.

Operation

The new system was developed to fulfill Strategic Air Command requirements for hemispheric weather support capability at every weather detachment that supports SAC operations. At Offutt AFB Weather Central, the largest of its kind in the world, weather data are gathered, analysed and plotted. Forecasts are made and then constantly re-evaluated and revised through current weather reports received from stations all over the world. Not only detachments of the Air Weather Service, but also U.S. Military bases throughout the world submit reports. Weather data flow in from land stations, airborne aircraft, ships at sea, and weather balloons.

The national weather analysis center at Suitland provides a daily report on winds and temperatures, and vorticity (or twisting) wind effects at high altitude, as well as prognoses of Northern Hemisphere weather.

The weather reports of foreign countries broadcast under the conventions of the World Meteorological Organization (WMO) are also used. Weather reconnaissance aircraft fly missions for the Air Weather Service and every SAC and MATS plane submits a complete weather report on the conditions in flight that it encounters. Every corner of the world must be weather reported in order to insure proper weather support of SAC's global mission.

Refueling missions at high altitudes and ballistic missile tests also require accurate weather information from all parts of the country. They need to know not only the usual information found along regular air routes, but also wind directions and speed, temperatures, vertical wind flow and cloud formations, at much higher altitudes than is usually required for commercial flying.

Over 500,000 word groups of weather information flow into the global center at Offutt AFB each day. As many as two million separate weather elements are considered and plotted on maps by personnel skilled in international weather codes.

In order to provide the world-wide weather capacity without the cost of a global weather central at every SAC base, the 3rd Weather Wing at Offutt must produce the weather service product that each SAC weather station needs, and distribute this product while it is still timely. Since the weather is constantly changing, the importance of timeliness in weather reports cannot be overemphasized.

*The author wishes to acknowledge the valuable assistance with photo material furnished by the Westrex Corporation (formerly Times Facsimile).

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Western Union Telegraph Co.

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Southwest Research Institute

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1964

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Association affairs

AFCEA Elections

During the opening day meeting of the board of directors at the AFCEA Convention, Benjamin H. Oliver, Jr., vice president, New York Telephone Co., was re-elected to serve a second term as national president of the Association. Reappointed were Col. W. J. Baird, as general manager and editor, National Headquarters of AFCEA, and as treasurer, W. Earl Trantham, manager, Eastern Operations, Hughes Products, Hughes Aircraft Co. Frank T. Ostenberg, acting secretary, was appointed secretary.

Maj. Gen. Frank Stoner, assistant to the president, Varian Associates, and Walter H. Pagenkopf, vice president, Teletype Corp., were elected as vice presidents. Mr. Pagenkopf is also a regional vice president.

Each year a new class of eight members are elected to serve for four years on the board of directors. Those elected as the class of 1964 are: John W. Inwood, district manager, Western Union Telegraph Co.; Francis L. Ankenbrandt, administrator, Global Communications Program, Defense Electronic Products, Radio Corporation of America; Charles F. Horne, vice president and manager, Convair-Pomona, Convair Division of General Dynamics Corp.; David R. Hull, who recently retired as vice president, Raytheon Co.; W. Preston Corderman, executive vice president, Westrex Corp.; E. U. DaParma, executive vice president, Sperry Gyroscope Co.; Dr. George L. Haller, vice president and general manager, Defense Electronics Division, General Electric Co.; Walter K. MacAdam, vice president, American Telephone and Telegraph Co.

All past national presidents will now serve on the board of directors as permanent directors according to a change in the AFCEA Constitution.

Due to this change Joseph R. Redman, communications consultant, Western Union Telegraph Co., and W. Walter Watts, group executive vice president, Electronic Components and International Operations, Radio Corporation of America, will leave the class of 1961 and become life members of the board. For the same reason Stephen H. Simpson, assistant vice president, Communications Research, Southwest Research Institute, will replace Dr. George W. Bailey, executive secretary of Institute of Radio Engineers, in the class of 1962.

Frank W. Wozencraft also will leave the class of 1961. However, as general counsel of the Association, he will remain a member of the board of directors.

The three new 1961 directors are: Paul S. Mirabito, general manager, Defense Contracts Division, Burroughs Corp.; Peter Schenk, executive vice president, MITRE Corp.; Major General George I. Back, USA (Ret.), assistant to the president, International Resistance Co.

Convention Summary

Attendance at this year's AFCEA Convention reached an all-time high of 4264 registered. More than 1200 people attended the banquet, setting a convention record, and heard guest speaker Leo Cherne, Executive Director, Research Institute of America. Over 1200 were present for the buffet, setting another attendance record.

The latest military electronics equipment was displayed by 83 industrial exhibitors in 160 exhibit units. Honoring 100 years of U. S. Army Signal Corps communications, special exhibits were displayed on Thursday, May 26, by the Army, Navy and Air Force.

Attendance at the panel discussions indicated a greater degree of interest than has been shown ever before. This issue of SIGNAL contains the complete presentation of the National Aeronautics and Space Administration and Bell Telephone Laboratories, Inc. panels. The August issue will carry the General Electric Company and Photography panels.

This year, for the first time, U. S. Army reservists were awarded retirement point credits for registered attendance at the four panel discussions during the Convention. Reservists who attended all four panels received 3 point credits.

Next year's convention will be held June 6, 7, 8, again at the Sheraton-Park Hotel, Washington, D. C. There are already 24 banquet and 13 buffet tables sold for next year.

Oliver Heads Relief Drive

Benjamin H. Oliver, Jr., AFCEA National President, was named chairman of the emergency Chilean Relief Committee of the American Red Cross, Albany County Chapter, New York. The committee was organized to appeal for funds to aid the 2 million people in Chile left homeless from recent earthquakes and natural disasters.

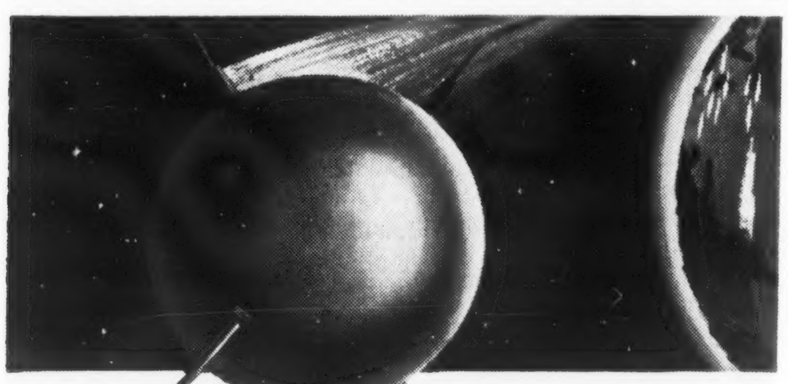
Radio Winner

Lieutenant (j.g.) Charles William Bollinger, Technical Advisor Writer of Electronics Curricula for the Naval School, was the winner of a transistor solar radio at the AFCEA Convention. The radio was donated by the Hoffman Electronics Corporation, Military Products Division, and presented by Mr. John O'Brien, vice president and manager of Hoffman's Washington, D. C., office. *(Continued on page 82)*

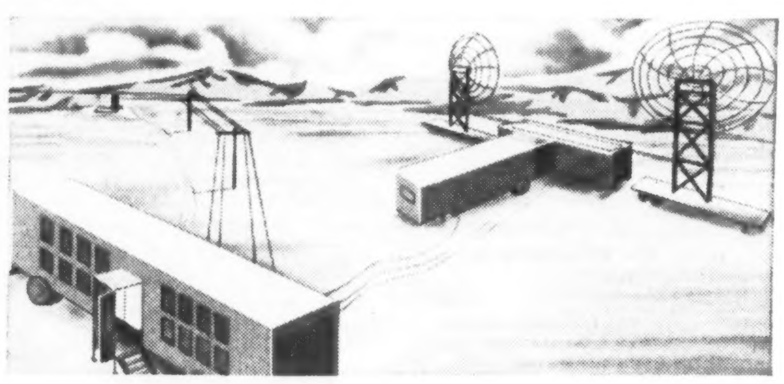
sig′nal (sĭg′năl), *n.* **1.** a monthly magazine. **2.** provides latest information about communications, electronics, photography. **3.** contains articles by outstanding leaders in military and industry. **4.** editorial policy consistently promotes civilian-military cooperation. — **Syn.** See INFORMATIVE: TIMELY: INTERESTING.

THE BIG A LEADS THE WAY TO *INTEGRATED* COMMUNICATIONS SYSTEMS

ADLER heterodyne repeater techniques have opened a wide range of UHF channels for U. S. Army field communications, and prevented obsoleting of millions of dollars of VHF equipment. Developed and manufactured by ADLER, the "F-Head" converter permits the basic AN/TRC-24 VHF system to be used for UHF relaying in areas where VHF spectrum congestion is a problem. Designed for plug-in use, the compact "F-Head" heterodynes the VHF output of the AN/TRC-24 to the **available** UHF range. ADLER heterodyne techniques also are employed in advanced TV microwave and repeater systems, and multichannel communications.



SATELLITE RELAY SYSTEM — A reliable, worldwide network for telegraphy and teletype communications will be realized through PROJECT COURIER of the Advanced Research Projects Agency and U. S. Army Research & Development Laboratories. Each of the Courier's air-ground transportable stations duplex transmit and receive 15 million bits of stored information in the 4-minute contact with the satellite. As subcontractor to ITT Laboratories, ADLER is responsible for design, manufacture and equipment installation of the ground station trailers of this earth-satellite relay system.



TRANSPORTABLE TROPOSPHERIC SCATTER SYSTEM— A new concept in continent-spanning tropospheric scatter communications soon will be available to the U. S. Air Force. For the first time, the full multichannel capability and reliability of a large, fixed installation will be provided in a compact, air-ground transportable package. The all-environment, 10kw, AN/MRC-85 is being designed and manufactured by ADLER under subcontract to Page Communications.

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Communications—Electronics—Photography

Listed below are the firms who are sustaining and group members of the Armed Forces Communications and Electronics Association. By their membership they indicate their readiness for their share in industry's part in national security. Each firm nominates several of its key employees or officials for individual membership in AFCEA, thus forming a group of the highest trained men in the electronics and photographic fields, available for advice and assistance to the armed services on research, development, manufacturing, procurement, and operation.

Sustaining Members

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Lenkurt Electric Co.
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Chapter News

Augusta-Fort Gordon

Representatives of the Army Southeastern Signal School at Fort Gordon explained the complexities of missile control in the air defense system at the April meeting.

On May 12 a barbecue was held at Julian Smith Park to raise funds for the third annual high school science scholarship. The scholarship, which is part of a national AFCEA program to stimulate interest in science, was awarded to a high school senior in the Central Savannah River Area and applied to first-year tuition at the college of the winner's choice.

Members of AFCEA and principals of area high schools selected the winner.

Baltimore

Election of new officers and a new Board of Directors, plus a talk given by Col. John E. Morrison, Jr., of the Office of the Director of Communications Electronics, Headquarters U.S. Air Force, were highlights of the April 19 meeting at the Deutsches Haus restaurant.

Col. Morrison is coordinator for the Joint Chiefs of Staff, Military Communications Electronics Board. His talk, "U.S. Air Force Aero-Space Communications," pointed out that the biggest role in the Air Force is played by SAC. The requirement of strategic bomber force communications is twofold, he said. It must have speed and reliability.

The new officers are: President, Cdr. Bob Kirsten, USCG; Executive Vice President, Robert B. Alexander, Vice President, Chesapeake & Potomac Telephone Company; Vice President, Programs, Richard M. Henry, Westinghouse Electric Corp.; Vice President, Membership, Edwin D. Darnall, Aircraft Armament Inc.; Vice President, Scientific Education, D. C. Lee, Westinghouse Electric Corp.; Secretary, Thomas E. Thompson, The Martin Co.; and Treasurer, Col. A. L. Baker, USA Sig. Sec., Ft. Meade.

The new Board of Directors serving April 1, 1960 through May 31, 1961 are: A. E. Abel, Bendix Radio Corp.; B. M. Brown, Westinghouse Electric Corp.; Charles E. Cogswell, Thompson Trailer Corp.; Capt. Vernon E. Day, USCG; Col. Riley A. Graham, USA Hq. 2nd Army; Vernon D. Hauck, Bendix-Friez Instrument Div.; Joel M. Jacobson, Aircraft Armaments, Inc.; William G. Morrel, Chesapeake & Potomac Telephone Co.; Albert J. W. Novak, Hoover Electronics Co. and John M. Pearce, The Martin Co.

The May 17 meeting was held at the U.S. Marine Corps Training Center, First Engineering Battalion USMCR. Lt. Col. James M. Joyner was host to the group.

Major General James Dreyfus, guest speaker, reviewed the progress and present status of military communications. He is Director of Communications-Electronics, Joint Chiefs of Staff, Office of the Secretary of Defense.

Dayton-Wright

Lieutenant General C. S. Irvine, USA (Ret.), Vice President of AVCO Corporation addressed 100 members of the chapter April 21 at the Miami Hotel.

He told those at the dinner meeting that, "The total military capability of this nation has the mobility, the depth and the flexibility to deter full-scale aggression at this point and time." He presented a gloomy forecast when he said, "I believe that the USSR has geared its research, development and production programs to a possible D-Day time in the future when our strengths are obsolete."

General Irvine said that our only notable advances "have been with Pioneer V and Tiros I, neither of which is a defense vehicle or weapon system." Although both represent steps forward, neither would help deter Soviet aggression.

"Our immediate and urgent planning should be directed toward regaining the front position," General Irvine concluded.

Fort Monmouth

On May 19 the chapter held its final dinner-meeting of the 1960 season celebrating the 100th anniversary of the Signal Corps. Speakers were Dr. George R. Thompson and Major General H. L. Scofield.

Dr. Thompson, Chief, Signal Corps Historical Division, Office of the Chief Signal Officer, spoke on the accomplishments and history of the Signal Corps from its beginning to the present day. General Scofield spoke on the proposed activities of the Signal Corps for the future. General Scofield is Chief, Procurement and Distribution Division, Office of the Chief Signal Officer.

Greater Los Angeles

Election of officers was the main business item at the chapter meeting May 11, at the Statler Hilton Hotel. Members also heard T. W. Johnson, Vice President, Security First National Bank speak.

Those elected to office were: President, Col. John W. Atwood, USAF (Ret.), Hughes Aircraft Co.; First Vice President, Lt. Cdr. Ray E. Meyers, USN (Ret.); Second Vice President, Col. Frank J. Shannon, USAF (Ret.), Packard Bell Electronic Corp.; Secretary, John H. Goodrich, Pacific Telephone & Telegraph Co.; Treasurer, Jay Debeau, RCA, West Coast Missile & Surface Radar Division.

Directors elected for a three year term are: John W. Inwood, Western Union Telegraph Co.; James G. Russell, Librascope, Inc.; Capt. John K. Knight, USNR, National Broadcasting Co.; and David G. Soergel, North American Aviation, Inc.

Directors elected for a two year term are: John F. Byrne, Motorola, Inc.; Col. Thomas L. McKnight, USAF, (Ret.), Glenair, Inc.; Charles A. LaHar, Radio Corporation of America and Charles McGuigan, Western Electrical Instrument Co.

Directors elected for a one year term are: Leonard D. Callahan, Gilfillan Brothers, Inc.; Lester R. Daniels, Turbo Dynamics Corp.; Richard Fuller, Bendix Pacific and Lt. Col. Loyd C. Sigmon, Golden West Broadcasters.

National Council Members elected are: John W. Inwood, Western Union Telegraph Co.; Adm. Charles F. Horne, USN (Ret.), Convair-Pomona; C. E. Kirk, Jr., Glenair, Inc. and Lt. CDR Ray E. Meyers.

Mr. Johnson, guest speaker, talked on "Business in 1960 Will Be Good for the *Good* Businessman." His talk highlighted the signposts looked for by major financial institutions in analyzing the potential of electronic and missile industrial firms.

Gulf Coast

Nearly 100 members and guests met May 2, at the Broadwater Beach Hotel for the dinner-meeting. SMSgt Robert N. Malone, vice president, presided in the absence of Col. George S. Walborn, president.

Guest speaker, Dr. Virginia Zachert demonstrated her "Tutor" machine. With this machine a student may correct his difficulties with punch board numbers that correspond with his choice of correct answers. If he errs, he is directed to return to the original selection, and with guidance from the machine, make a new choice.

Dr. Zachert will be at Keesler Air Force Base for six months to fulfill an Air Force contract for preparing instructional material in the Electronic Principles area.

Kansas City

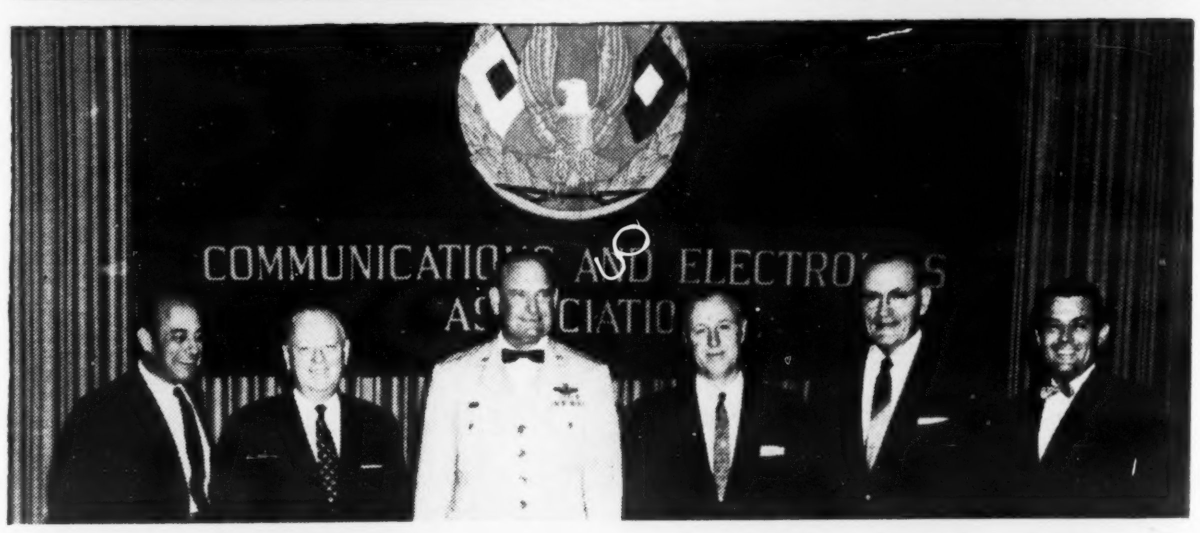
Sixty-five members and guests attended the meeting on May 5 at the Officers Club, Richards Gebaur Air Force Base. Special guests were Major

(Continued on page 71)

Atlanta—Colonel Kirk Buchak, Third U. S. Army Signal Officer, newly elected president of the chapter is being congratulated by the retiring president, Mr. A. E. Arnold, district manager, Western Union.

Baltimore—John J. Slattery (right) is shown accepting a certificate for group membership for the Martin Company from George C. Ruehl, Jr., regional vice president J. Walton Colvin, chapter president and Col. John E. Morrison.

Cape Canaveral—Shown at the charter meeting are L to R: Gen. Dudley Hale, USAF (Ret.); T. J. Tully, Radio Corporation of America, chapter president; Col. R. E. Northcutt, Patrick Air Force Base, Commander; Benjamin H. Oliver, Jr., National President, AFCEA; M. C. Nolan, vice president, Royal McBee Corp.; William H. Alvis, Western Union.



Dayton-Wright—Lt. Gen. C. S. Irvine, USAF (Ret.) speaks at the chapter's April meeting. Pictured L to R at the speaker's table are: Byron Boetscher, past president of the chapter; Paul Clark, regional vice president; Gen. Irvine; William Shade, president; Mrs. Shade; Mrs. Magill; James J. Magill, past president.

London—Shown at the Annual Spring Ladies Night held in April are L to R: Lady Payne Gallwey; Sir Reginald Payne-Gallwey, vice president, Bart Associates; Col. J. A. Plihal, chapter president; Mrs. Plihal.

(Continued from page 69)

General W. W. Bowman, Commander 33rd Air Division; John R. Parsons, Division Manager, Southwestern Bell Telephone Co., Western Missouri Division; and Judge Henry A. Reiderer, Judge of the Juvenile Court of Kansas City.

Judge Reiderer, guest speaker, gave a talk on juvenile delinquency, its causes, corrective action taken by the juvenile court and its effect on the community. A question and answer session followed.

Guest speaker at the June 2 meeting was Major General W. W. Bowman.

Election of officers also took place. Results were: President, Lt. Col. G. D. Meserve, USAF (Ret.); Executive Vice President, Lt. Col. Zed W. Barnes, USAF; Vice President, Paul Henson, United Utilities; Vice President, W. J. London, Southwestern Bell Telephone Co.; Secretary-Treasurer, R. P. Baker, Southwestern Bell Telephone Co.

Directors are: W. R. Massarand, American Telephone & Telegraph Co.; M. H. Tyrrell, Southwestern Bell Telephone Co.; William B. Foulis, Jr., American Telephone & Telegraph Co.; W. E. Goll, Manufacturing Representative; R. Harvey, Western Electric Co.; Kermit Karns, Federal Aviation Agency; J. T. Wallingford, Central Tech. Institute and James Neustadt, Burstein-Applebee Co.

London

The Annual Spring Ladies Night was held April 28 at the Columbia Club. One hundred members and guests enjoyed dinner and dancing. Each lady present received a corsage and a favor.

Chapter President, Col. Joseph A. Plihal and Mrs. Plihal presided over the evening. Their guests included Sir Reginald and Lady Payne-Gallwey.

Louisiana

On May 30 the chapter held a Fellowship Buffet Party. Members and guests gathered in the Prince Regal Room of the American Brewing Co.

Montgomery

Lt. Col. Herbert Herman was elected to serve a third consecutive term as president of the chapter at the meeting April 29 at the Maxwell Air Force Base Officers Club.

Others elected to office were: Vice President, A. B. McFerren; Secretary-Treasurer, Luther L. Hall; Program Chairman, W. Lyle Hinds; Membership Committee, Cal S. Weiss, Col. Sterling K. Briggs; Directors, James B. Fitzgerald, Sidney W. Reese, Maj. George W. Mosall, Lt. Col. Charles A. Bell, Maj. John D. Lynch and Madison M. DeShields.

Following the business meeting, James Cantrell and Warde Adams of Orradio, a subsidiary of Ampex, presented a motion picture and demonstration on the manufacture and use of their magnetic tape.

North Carolina

Members elected the chapter's 1960 officers at the dinner-meeting on April 26, in the John R. Hodge Room of the Fort Bragg Officers Open Mess.

Those elected were: President, J. F. Havens, Vice President, Carolina Telephone and Telegraph Co.; First Vice President, Col. Paul Von Sloan, USA, Signal Officer, XVIII Airborne Corps; Second Vice President, E. M. Veale, Southern Bell Telephone and Telegraph Co.; Secretary-Treasurer, J. C. Coley, Manager, Carolina Telephone and Telegraph Co.; National Committee Member, W. T. Edwards, Chief Engineer, Southern Bell Telephone and Telegraph Co.; Directors, H. D. Holderness, President, Carolina Telephone and Telegraph Co.; Brig. Gen. J. W. Stilwell, USA, XVIII Airborne Corps; H. E. Hussey, President, General Telephone Co.; W. E. Forehand, D. P. S. American Telephone and Telegraph Co.; F. E. Henderson, Assistant Vice President, Western Electric Co., Inc. and E. A. Clement, Assistant Vice President, Southern Bell Telephone and Telegraph Co.

After the business meeting Richard Gale presented a program on Military Application for Automatic Data Processing. Mr. Gale is Chief of the Data Processing Branch, Signal Research and Development Laboratory, Fort Monmouth, New Jersey.

Northeastern University

Student members heard Charles French speak on "What is a Computer?" at the meeting May 5. Mr. French, a former Marine Corps instructor in Radio Relay Repair, is Boston Branch Manager, Datamatic Division, Minneapolis-Honeywell, Inc.

Mr. French explained some of the mechanic and basic concepts of the computer in his talk.

Another meeting sponsored by the Student Chapter and the Reserve Officers Training Corps at Northeastern heard a talk by J. Russell Dolan. He spoke on "New Product and Market Trials."

Mr. Dolan is General Marketing Supervisor for the New England Telephone and Telegraph Co.

Pittsburgh

The chapter held its annual dinner on June 8. Guest speaker was Dr. B. vonHaller Gilmer, professor and head of the Department of Psychology at Carnegie Institute of Technology.

Dr. Gilmer discussed the use of electro-pulse stimulation to the skin as a means of communication with astronauts, frogmen and others whose main means of communication are otherwise occupied by deafening noises or concentration on equipment. This new concept of communication is of great importance as we approach the space age, Dr. Gilmer said.

Rocky Mountain

On April 26 over 100 members of the chapter heard Dr. Van Atta speak on the role of industry and educational institutions to further scientific education and to encourage gifted children and college students in various scientific fields. Dr. Van Atta, one of the nation's leading authorities on scientific education is Scientific Education Advisor to Hughes Aircraft.

The meeting was held at the Air Force Academy Officers Club.

On May 18, at the Continental Denver Hotel in Denver, W. E. Burke spoke to members. Mr. Burke is Vice President of Western Electric Co., in charge of all defense projects.

San Francisco

Following a dinner-meeting on May 19, members of the chapter toured the Westinghouse Missile Launcher Project manufacturing facilities. Hal Leler of Westinghouse also showed a new 15 minute film on development of the fleet ballistic missile.

San Juan

Thirty-four members attended the regular monthly meeting held at the Officers Club at Fort Brooke on April 21. The election of officers constituted the new business for the evening.

Results of the election were: President, Clyde Dickey; First Vice President, Lt. Col. W. C. Smitherman; Second Vice President, Kinne Prachel; Secretary, A. R. Crumley; Treasurer, Jorge Toledo; Board of Directors, Homero Cordero, Harry Compton, Juan Castanera, Eugene Klein and Joaquin Gandia.

Scott-St. Louis

On May 6 chapter members heard F. N. Story speak at a dinner-meeting. Mr. Story, St. Louis Area Director of the Dale Carnegie Courses spoke on "How to Succeed in Spite of Yourself."

South Carolina

At the meeting on May 18, at Shaw Air Force Base, Mr. T. E. Mardis, who is on the Technical Staff of the Bell Laboratories, spoke on "Space Age Electronics."

The chapter announced new officers who were nominated by the board of directors. The new officers are: president, Lt. Col. Robert J. Green, Shaw AFB; first vice president, H. L. Lackey, general commercial supervisor, Southern Bell Telephone and Telegraph Co.; second vice president, Major Harvey W. Powell, Shaw AFB; secretary-treasurer, D. D. Harris, South Carolina coordinator of defense activities, Southern Bell Telephone and Telegraph Co.; directors, Major Guy H. Able, Jr., J. E. Butterworth, training supervisor, Southern Bell Telephone and Telegraph Co., and LCdr. E. R. Knickel.

Montgomery—Pictured at the April meeting are L to R: chapter president, Lt. Col. Herbert Herman, Communications and Electronics Doctrinal Division, Research Studies Institute, Air University, and guest speakers, Mr. Warde Adams and Mr. James Cantrell of Orradio Division of Ampex; Sidney W. Reese, chief engineer, Southern Bell Telephone Co., Birmingham; Col. William H. Lyle, Communications and Electronics Doctrinal Division, Research Studies Institute, Air University.

Washington—Sp-5 Hal Hill, a signalman from Fort Monmouth is shown participating in the kick-off program of the Signal Corps centennial, "Voices of Army Signalmen of the Past and Future," at the May meeting. Dressed in Civil War uniform, he told of war experiences during that time.

USAF Bomb Alarm System

(Continued from page 55)

cient amplitude and rises in less than a predetermined number of microseconds. If triggered, the multivibrator operates at the end of a set period of time and reads the voltage stored on the first integrating condenser. This voltage represents the energy contained in the first few microseconds of the initial peak associated with a nuclear detonation. If there is sufficient voltage on the first integrating condenser, a second monostable multivibrator operates and at the end of one second reads the voltage on the second integrating condenser. This voltage represents the energy in the first second of time of the second peak of the flash and, if sufficient, it triggers a third monostable multivibrator. The operation of this third monostable shifts the frequency of the oscillator for a period of one second, which, in turn, opens a gating circuit and releases the alarm signal.

This series of tests which each light flash must pass is rigid. First, the thermal energy must lie in a specific wavelength range. Second, the rise time of the flash must be very short, in the order of a few microseconds. Third, the intensity or amplitude must be at least comparable to that of the noonday sun. Fourth, the flash must contain a substantial amount of energy in the first peak. Fifth, the second peak must also rise to a high value and contain a very large amount of energy.

No naturally-occurring event could produce the correct combination. Direct sunlight has the correct wavelength and intensity values to satisfy two of these requirements, but it could not, by any combination of circumstances, be occluded for a period and then rise to full value in a few microseconds. Lightning has a fast rise time, but its intensity is low and its spectral distribution is such that much of its energy falls outside the acceptance range of the sensor. Lightning also does not last long enough to produce sufficient energy to satisfy the discriminator. Even repeated lightning flashes fall far short of satisfying the energy requirement. A large photo flash bulb, producing light at the sensor which is more than one thousand times stronger than the minimum nuclear event will not cause an alarm. This is true even when its effect is increased one hundredfold by removing the perforated metal shield which covers the photo cells before firing the flash bulb. Under these conditions, the flash is so intense that it causes paper to burst into flame, but the sensor does not report an alarm, nor are the photo cells damaged by the heat.

The sensor includes a built-in test flash device which can be triggered from a central information point to assure that any given sensor is in full operating condition. To further assure constant readiness of this system, each sensor is interrogated every few minutes from a central facility. If any component part of the system, including the wire lines, becomes inoperative, a positive signal appears at several control points and immediate corrective action is taken. Thus, it can be seen, that the Bomb Alarm System has an inherent "confidence factor" in that the status of every individual sensor is known at all times.

Several Master Control Stations are planned in such a manner that any one can assume the functions of the others. Their function, as the name implies, is to control all operations of the system and to feed information received from the sensors to the individual display boards. The boards are opaque glass map outlines of the United States. Alarm lights installed behind the glass panels will light only when an indication is received that a nuclear weapon has been detonated at a particular target area.

NEWS ITEMS AND NEW PRODUCTS

A national symposium on *Temperature—Its measurement and Control in Science and Industry* will be held in Columbus, Ohio, March 27-31, 1961. The symposium is jointly sponsored by the American Institute of Physics, the Instrument Society of America and the National Bureau of Standards, with other agencies and societies cooperating.

This will be the first conference of this scope since the New York conference on the same subject in 1939. The symposium will be aimed at the fundamentals of temperature measurement to complement the material in the 1939 volume and will provide an authoritative blending of papers on the meaning of the temperature concept as well as analytical theory, with appropriate emphasis on instrumentation and the engineering aspects, e.g., thermo-couples and radiation pyrometry in full range of temperature. Interests from cryogenics to ultra high plasma temperature will also be covered.

Those interested in contributing to the program should contact Dr. Herzfeld at the National Bureau of Standards, as early as possible for details.

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The Army will place a six-pound electronic device called a transponder aboard a U. S. Navy Transit satellite next fall to assist the Army Map Service in obtaining more precise geodetic and mapping information.

The transponder is a combination radio receiver-transmitter and is a component of the SECOR (Sequential Correlation Range) system that measures distances by radio.

Considered part of the "Project Betty" operation, which has three MINITRACK MARK II stations on Pacific Ocean Islands taking observations on the Navy VANGUARD satellite, the new system is better suited than MINITRACK to the Army Map Service Accomplishment of its geodetic mission. It will measure distances representing the sides of triangles extending from the earth stations to the Transit borne instrument instead of the measurement of space angles under the present system.

The new system is expected to provide better data for determining geodetic quantities such as the figure of the earth, intercontinental ties and location of small isolated islands to a common reference system. Another anticipated geodetic by-product, important for guidance systems of intercontinental missiles, is more precise information on the earth's gravitational field.

SECOR is being built by the Cubic Corporation, San Diego, Calif., which is working with the Applied Physics Laboratory of Johns Hopkins University, the Navy Transit contractor, on integration of the SECOR package in the Transit satellite.

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Financial assistance for eligible applicants wishing to receive civil defense leadership and instructor training is available from the Office of Civil and Defense Mobilization.

The assistance was authorized under an amendment to the Federal Civil Defense Act voted by Congress last year. The Student Expense Program was developed to encourage States and their political subdivisions to increase their civil defense mobilization capabilities through special training for key people in their jurisdiction.

Payment is made to eligible students for up to one-half of their expenses in attending an ACDM school.

Further information may be obtained from any State Civil Defense Office.

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Five hundred mobile "desk-top radio stations" are being built by Dynamics Corporation of America, under a $500,000 contract, for use in a worldwide Air Force communications network known as MARS (Military Radio System). Designed to link Air Force posts both in the United States and overseas and to provide a secondary Air Force communications net in case of emergency, the portable transmitting receiver systems employ the "single sideband" electronic technique, which provides sharper, clearer signals over longer distances than conventional radio communication methods.

Deliveries under the contract, with Griffiss Air Force Base, Rome, New York, began in May and are expected to be completed by DCA's communications subsidiary, Radio Engineering Laboratories, by September of this year.

The radio stations are completely standardized so that the units and parts of all 500 systems are interchangeable. They consist of small transmitter (12 inches long and 7 inches high), a receiver of identical size, a control unit and power supply.

Because of the single sideband method of communication, the transmitters, while only of 100 watt power, can carry clear voice messages half way around the world under favorable atmospheric conditions. With this technique the full power of the transmitter's signal is concentrated in one "sideband," thus providing four times the signal strength of conventional transmitters (which broadcast a "carrier wave," plus two "sidebands").

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An electronic translator capable of turning Russian into English at the rate of 35 words a second has been developed under a five-year project at the USAF Air Research and Development Command's Rome Air Development Center, Griffiss AFB, N. Y.

The translator is the only one of its kind in existence and has been in use on an experimental basis since June 1959. According to Air Force engineers, translation at this point is on a word-for-word basis. However, the machine gives the general content of a Russian article. By the end of this year a word analyzer with logic circuits for sentence structure will be added into the translation complex.

Heart of the automatic language translator is a "photoscopic memory" invented by Dr. Gilbert W. King of International Business Machines Research Center, Yorktown Heights, N. Y. This dictionary unit, a transparent disc ten inches in diameter, can store 550,000 Russian-English words in an area the size of a postcard. They appear around the edge of the disc in concentric tracks of binary code. As a Russian word is fed into the translator via a punched tape, it is "read" by the machine and converted into electrical signals. These are matched in a lightning dictionary drilled with the coded equivalents on the glass disc. The English translation is transmitted over an electric typewriter. Any word in the dictionary disc can be located by the machine in less than one-300th of a

second.

If the translator does not find a word in its glass listing, it transcribes it in red for later inclusion.

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Radio signals received by a tracking station from a satellite must be identified by the date and time of the observations. To aid in providing a standard timing technique an experimental code is now being transmitted by the National Bureau of Standards as a part of the NBS standard frequency shortwave broadcasts over station WWV, Boulder, Colorado.

This experimental code and broadcast was developed by a number of organizations and individuals including the Inter-Range Instrumentation Group, the National Aeronautics and Space Administration, Convair Astronautics and NBS.

The new time-code generator which is used to pulse modulate the WWV signal was designed and built by Electronic Engineering Company of California who also helped with the generator installation.

The experimental broadcast, as is true of the regular WWV transmissions, is supervised, monitored and controlled by the Radio Broadcast Services Section of the National Bureau of Standards' Boulder Laboratories.

The code on WWV is an experimental step toward achieving standardization on a world-wide basis. It is expected to have a great potential for many users rather than being restricted to a particular segment of research.

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A teleprinter using an electronic distributor has been developed in the Engineering Laboratory of the University of Roorkee in India.

Many modern teleprinters use mechanically operated cam type distributors, but the recent trend in the industry is to develop electronic ones. This was reported in a paper by N. N. Biswas and Prof. H. Rakshit, of the University of Wisconsin, Madison, Wisc., delivered during the Summer General Meeting of the American Institute of Electrical Engineers.

"The distributor uses a ring counter consisting of cold cathode trigger tubes," the paper explained. "Timing pulses are derived from the 50 cycles main supply. The 1.5 unit stop pulse is ensured by a method of reversing the phase of the sinusoidal supply driving the pulse generator during the stop period of each signal train. Since no hot cathode tube has been used at any stage of the distributor, it does not require warm up time. The distributor can be fed either directly from the keyboard or from perforated tape. It can also be made to work from a 5 or 6-unit code by a core-selector switch."

The electronic distributor has a limitation in that it can transmit only at a speed of 50 "bauds." In the United States where electricity is supplied at 60 cps the distributor will work at a speed of 60 bauds.

The chief advantage of the electronic distributor is that "the timing oscillator remains free running and there is no need to double its frequency during the stop period to obtain a 1.5 unit stop pulse."

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Development of a tiny, dice-sized sub-module has been jointly announced by the U. S. Army Signal Corps and Republic Aviation Corp. The half-inch cube modules, each holding anywhere from 12 to 18 components and weighing 2 grams, will be used in the guidance system of the AN USD-4 Swallow reconnais-

sance drone the company is building for the U. S. Army Signal Corps.

The module is said to be suitable for use in any all-purpose digital computer whether for military or commercial use. It has a packing density of a quarter of a million parts per cubic foot, or five times the density attainable through standard circuit techniques.

Discussing the use of the modules in the navigational computer which is the heart of the Swallow's central system, Republic's missile engineers say the units are arranged on modular cards at a rate of 44-50 per card. The new units are uniform in size, which means the cards can be stacked on top of one another with no wasted space between. The size of the Swallow's computer has been kept down to 2 cubic feet, including memory drum.

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An S-Band Ferrite Isolator spanning a full octave in frequency range has recently been developed using new ferrite and waveguide techniques.

The Isolator, developed by Kearfott Company Inc., Microwave Division, Van Nuys, Calif., has a frequency range of 2.1 to 4.3 kmc sec. Isolation is 20 db/min.; insertion loss is indicated at 2 db/max. with Type N Connector; peak power is achieved at 1000 W. max. and average power at 5.0 W. max. Ambient temperature is 65°C maximum.

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Westinghouse Electric Corporation has announced the successful development of a thermoelectric generator for the Bureau of Ships, U. S. Navy. The generator delivers five kilowatts of electric power by the direct conversion, without major moving parts, of heat into electricity. It is 50 times more powerful than any previously described thermoelectric power plant, the company reports.

The generator is the largest unit developed under a joint Army, Air Force and Navy thermoelectric power program coordinated by the Navy's Bureau of Ships. It is an experimental unit intended for evaluation of power generating materials and fabrication techniques which have been produced under a Navy-sponsored thermoelectric materials research program. The rate of progress during the last 3 years of this program supports Navy hopes for an early achievement of practical thermoelectric generators of considerably larger size.

The new generator is built from thermoelectric assemblies, or modules, which can be arranged electrically to give a wide range of output voltages and currents. These combinations range from 10 volts at 500 amperes to 120 volts at about 42 amperes. This modular construction gives versatility in physical design, permitting the generator to be built as two identical "sub-generators" which are connected together to give the full power output, or which can be used independently of one another as separate 2500-watt power plants.

The thermoelectric portion of each 2500-watt "sub-generator" resembles a hollow cylinder about 30 inches in diameter and 30 inches high. The thermoelectric modules form the walls of the cylinder, their hot inner surfaces exposed to the flame of burning kerosene; their outer surfaces are cooled by water which is piped to them. The only moving parts in the entire 5000-watt unit are those in the pumps for cooling water and for the kerosene fuel burners. Both are operated by electric motors which receive their power from the electrical output of the generator itself.

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LIBRAGAL is a new computer developed by the Librascope Division of General Precision Inc. The GAL portion of the device's name stands for Guidance and Launching.

The LIBRAGAL will be used in the guidance system of a tactical missile. Contract specifications call for a program which will evaluate the feasibility of a target, control the countdown, raise the launcher, fire the missiles, provide flight navigation and guidance and finally, detonate the missile on target.

The computer is packaged in two sections — a general-purpose digital computer with high capacity through advanced logical and component design, and an input-output module which is easily adapted to the individual application. Within the general-purpose element, the LIBRAGAL utilizes air-cooled sandwich-type logic cards designed to fit the shape of the interior surface of the missile shell. With this shape, the computer occupies a 60-degree sector of the missile's circumference, extending to within approximately 6 inches of the central axis of the missile and giving the computer a cross section shaped roughly like a keystone. The plug-in cards are mounted so that the plane of each is normal to the missile's longitudinal axis. The electronic components are mounted between two etched circuit cards so that the thrust

of the missile exerts a force parallel to the mounting leads of each component. Plug-in connectors for the cards are of the pin-and-socket type.

The computer utilizes a "Three-Plus-One" command structure which gives it a zero-access time capability. Each instruction contains three operands and the address of the next instruction. The combined capacities of this command structure and the logical design of the components enable the LIBRAGAL to perform a vector-magnitude computation from a single instruction.

For its memory, the computer utilizes a rotary magnetic drum with a capacity of 3,000, 22-bit words on 46 tracks. The computer operates with 16 basic orders which can be utilized to create up to 100 separate control functions.

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Specialaire is a new dust-free illuminated work chamber with double filtration for air cleanliness. The self-contained cabinet was designed to provide high dust arrestance for assembly, research and test of ball bearings, optical components and other precision instruments in both cleaned and non-cleaned areas.

Use of the new portable cabinet with a continuous flow of filtered air prevents fine dust particles from entering the work area. The cleaned air passing out of the cabinet acts as a shield against lint, pollen, dust or dust-borne bacteria. The self-charging electrostatic filtration has an arrestance value of 95% on dust particles ranging from .08 to 80 microns in diameter.

The Specialaire Dust-Free Cabinet features a hinged panel to permit insertion of large work specimens, permanent washable type filters and adjustable air flow.

Additional information on Specialaire may be obtained from Specialties, Inc., Sknunks Misery Road, Syosset, L. I., N. Y., developers of the product.

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The television studios of the Army Southeastern Signal School—a pioneer in the development of educational and closed-circuit TV—have a method of teaching television technique in three hours, thereby keeping the gray out of directors' hair and at the same time improving the quality of its programs.

The capsule course is conducted twice a week by professional studio personnel who aim to impart basic production procedure together with an understanding of how television can be applied to lectures, demonstra-

tions and other training devices in support of classroom instruction at the Signal School.

No one is obligated to attend, but anyone likely to appear "live" before the camera at one time or another usually takes advantage of this course. High ranking officers, instructors and key personnel associated with the school comprise the bulk of the classes. An average workshop contains five students.

Among other things, the potential performer is taught hand signals, correct personal appearance, equipment terminology, how to read a teleprompter and cue cards. He gains experience "on camera" being required to speak spontaneously for three minutes on a foreign topic, then reads from a teleprompter for two minutes in front of a two-camera setup.

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Kahn Research Laboratories, Inc. of Freeport, N. Y. is producing an SSB-58-1A Single Sideband Exciter/Driver system for use in high level AM ground station transmitters and, a Single Sideband receiver for AM broadcast use.

The Exciter/Driver system is based upon Class C sideband amplification. The company reports advantages over conventional linear SSB systems have been confirmed by commercial and government use during the past seven years. It is designed for use with new AM transmitters at reductions in over-all SSB system costs. Existing AM and CW transmitters can be converted to SSB operation.

The Receiver is designed for relaying radio broadcast signals, program monitoring in difficult reception areas and various Conelrad applications. High front end selectivity reportedly reduces adjacent channel interference, even when interfering signals are stronger than the desired station. Product demodulation, utilizing local carrier or reconditioned carrier insertion to minimize selective fading distortion, or conventional AM diode detection can be selected by front panel switch to suit local reception conditions. Upper or lower sideband reception is also selected by front panel switch. The Receiver operates on 110 volts AC or emergency battery.

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Teletype Corporation of Chicago is offering a new 20-page, brochure entitled *Teletype 28 Stunt Box* to provide users and potential users of Teletype Model 28 equipment with an understanding of how Model 28 page printers and automatic send-receive sets can be utilized to maximum capabilities.

Detailed explanations should be of interest to those concerned with message and data communications system design, integrated data processing, automation, data collection, production control, code conversion, digital telemetering, error checking and similar applications. Free copies are available upon request to Teletype Corp., Dept. SP-9, 4100 Fullerton Ave., Chicago 39, Illinois.

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Manpower—Challenge of the 1960's is a new publication of the U.S. Department of Labor. The pamphlet shows the changes in our population and labor force which are expected to take place between 1960 and 1970.

Major shifts in occupational and industrial structure will accompany these changes which have important implications for the education and training of young people, as well as the management and utilization of our overall labor supply.

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Proceedings of the National Electronics Conference 1959 (Volume 15) are available at $10.00 each from National Electronics Conference, Inc., Room 2104, 228 North LaSalle St., Chicago 1, Illinois. The book contains all of the technical papers and addresses presented.

The 109 technical papers cover electronic research, development and application of antennas, circuits, communications, computers, electron tubes, engineering management, instrumentation, magnetic amplifiers, materials and communication, microwave, radar, servomechanisms, solid state devices, parametric amplifiers and, engineering and speech.

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A data processing reference guide has been published by Gille Associates, Inc., Detroit, Michigan.

Designated The Punched Card Data Processing Annual, the edition features a computer guide, displaying all commonly used types of electronic computers, with basic descriptions and characteristics. A chart is included which compares the different types of computers and gives specifications for each. Included also is a detailed survey of applications now in use and those rejected showing statistics for all principal functions and types of business. A directory lists local sources (40 largest U.S. cities) for most supplies and services commonly used in data processing departments.

Copies are available at $15.00 from Gille Associates, Inc., 956 Maccabees Building, Detroit 2, Mich.

The National Science Foundation has published *Statistical Handbook of Science Education* (NSF-60-13), a compilation of statistical material on the education and training of scientists and engineers in the U.S. It should prove to be a useful reference work for anyone interested in science and engineering education in the U.S.

The major parts of the publication deal first with human resources data — population, educational levels of the population; college degrees awarded, qualifications of teachers; second, with institutional and financial data—number and types of schools, expenditures, tuition costs, financial aid; and third, with general appendix tables containing more detailed information on all these subjects.

Copies may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C., at a price of 55 cents.

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The Electron Tube Information Council, which consists of seven of the nation's leading receiving tube manufacturers, has published a new fact book, *Tubes and Transistors: A Comparative Study*.

The new fact book discusses the advantages and limitations of both components and would be useful to equipment manufacturers and design engineers in their selection of the most practical device for specific applications.

The Electron Tube Information Council is composed of representatives of C.B.S. Electronics, General Electric, RCA, Raytheon Corp., Sylvania, Tung-Sol Electric Inc., and Westinghouse Electric Products. For further information, contact Electron Tube Information Council, 554 Fifth Avenue, New York 36, New York.

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Human factors that influence the design of space-age electronic equipment will be the subject of a joint research program by The Catholic University of America, Washington, D. C. and the electronics division of ACF Industries, Incorporated, Riverdale, Maryland. The university will supply personnel and facilities of its experimental and physiological psychology laboratories and ACF Electronics will contribute engineering and production support as well as the services of its human factors department.

Dr. John C. Townsend, professor of psychology at the university, and Jack R. Huffner, chief of the human factors group at ACF Electronics, will jointly direct the program.

According to Mr. Huffner, the decision-making project will be directed at determining how better to train humans to make decisions in situations requiring the complex assimilation and integration of information.

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The training and development of young engineers in the U. S. is of major concern to the nation, according to Dr. T. Keith Glennan, Administrator of the National Aeronautics and Space Administration and President-on-leave of the Case Institute of Technology, Cleveland, Ohio.

Dr. Glennan is a staunch supporter of a program sponsored by the Engineers' Council for Professional Development, an organization that is helping guide young engineers on their way to maturity in the profession. The Council is headed by W. L. Everitt, Dean of Engineering of the University of Illinois.

"The need for professional development programs is becoming more acute with every scientific advance," said Dr. Glennan during a recent Washington meeting with Dean Everitt. "The Engineers' Council definitely is heading us in the right direction."

As an antidote for post-college slump encountered in the careers of young engineers, the Council has offered a program designed to close the gap between college and the realities of earning a living, Dean Everitt explained.

The program has caught on in several cities and a number of industrial firms are actively supporting it. W. G. Torpey, consultant to President Eisenhower on engineering utilization, has reported that methods whereby local groups of employers of young engineers may establish a similar program in their own areas are being reviewed at a series of utilization conferences. These conferences are sponsored by the Office of Civil and Defense Mobilization, Executive Office of the President.

Dean Everitt was a member of the President's Committee on Scientists and Engineers that devised the utilization conference pattern under which 32 local conferences have already been held. For further information, contact Engineers' Council for Professional Development, 29-33 West 39th Street, New York 18, New York.

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Cook Electric Company of Chicago has developed a high torque polarized motor with the stall current equal to the low running current.

The unit is a D.C. motor without commutation and has a high starting and running torque for a given watt input. The current consumption of the motor is described as nearly constant, even with locked rotor or load variations. There is no significant current change as the load on the motor increases.

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An X-band video detector microwave diode for use in radar, communications systems, countermeasure and other microwave applications, has been announced by Sylvania Electric Products Inc., a subsidiary of General Telephone & Electronic Corporation.

The new diode (Type 1N31A) developed on a U. S. Army Signal Corps contract, meets the full range of military environmental tests including temperature cycle, shock, vibration, centrifuge, and moisture resistance.

Type 1N31A is a high temperature (150-degrees C) hermetically sealed diode in a coaxial package. It has a figure of merit of 200 minimum at 9375 MC and a video impedance range of 3,000 to 17,000 ohms.

Photoprogress

Eastman Kodak Company has published a reference guide for metallurgists covering photomicrography of metals. The 46-page data book is illustrated with photographs, charts and graphs, and contains six major sections which include detailed information on the metallographic microscope, illumination, filters in metallography, photographic materials, exposure determination and, processing and printing.

The optics of metallography are discussed at length, including specific suggestions and recommendations for matching proper equipment to various applications. Practical information is given on determining exposures for both black-and-white and color materials. Another section probes filters and their use in connection with various light sources, specimen types and objectives.

The book is available at 50 cents per copy through Kodak dealers or may be ordered directly from Sales Service Div., Eastman Kodak Co., Rochester 4, New York, for 50 cents plus 10 cents for handling.

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Synchronization of satellite tracking cameras spaced 200 miles apart to within 10/1000ths of a second (0.1 milli-second) is described in a technical paper on *Ballistic Camera Synchronization System* now available from the Electronic Engineering Company of California. The Ballistic Camera Synchronization System was designed in cooperation with the Ballistic Research Laboratory, Aberdeen Proving Ground, Md., for the Army Ordnance Corps and developed and built by Electronic Engineering Company. The system consists of a central camera control station and two remote control stations.

The paper was written by Senior Engineer John B. Shannon who headed the project. Copies are available from the Sales Dept., Electronic Engineering Co., 1601 East Chestnut Avenue, Santa Ana, California.

Names in the News

Hugh C. Bream has been named president and general manager of Western Design, Santa Barbara Airport, Goleta, California, a division of U. S. Industries, Inc. He was previously manager of Western Design's Santa Barbara division.

Dr. D. M. Allison has been appointed technical assistant to the vice president of engineering and research of the Bendix Corporation. He will serve as the liaison officer between Bendix and technical agencies of the government engaged in the development of major scientific and engineering projects. He previously was manager of Bendix radio division government products group.

Edward Stipek has been appointed customer service representative for Ryan Electronics, division of Ryan Aeronautical Company, San Diego. He will represent the company at Wright-Patterson Air Force Base, Dayton, Ohio and other military and industrial contractors in the midwest. He was formerly associated with Stewart-Warner Electronics, Chicago.

Dr. Victor J. Young has been elected vice president of Hazeltine Electronics Division, Hazeltine Corporation. He is in charge of the Electrical Engineering Department. Since 1956 he has been an assistant vice president of the electronics division.

H. Myrl Stearns, president of Varian Associates, received an honorary Doctor of Science degree at special ceremonies at the 65th commencement exercises of the University of Idaho, Moscow, Idaho, June 5. He has served as executive vice president and general manager of the firm since 1948. In June 1957 he was named president.

Robert C. Sprague, chairman of the board of the Sprague Electric Company, has been elected a fellow of the American Academy of Arts and Sciences. In 1957 he served as chairman of the Gaither Committee to assess American defenses.

Francis M. Ryan has been elected vice president and director of engineering at Page Communications Engineers, Inc. He formerly was head of the Radio Section of the Headquarters Organization of the American Telegraph and Telephone Co.

Lawrence J. Fay has been appointed chief engineer of Equipto Electronics Corporation. He will direct engineering activities in product line design, research and development, and the necessary engineering support for the company's sales and production activities.

Walter A. Kirsch has joined Telechrome Manufacturing Corporation, Amityville, N. Y., as defense products manager and assistant to the vice president and director of sales. For the past year he was a sales engineer for the Servo Corporation of America. Mr. Kirsch is a director of the New York Chapter of AFCEA.

Association Affairs

(*Continued from page 63*)

To qualify for the drawing, individuals viewing the exhibits were asked to have a card time stamped at each of five locations throughout the exhibit area. Col. W. J. Baird, general manager of AFCEA, drew the winning card at the close of the exhibits on May 26. Pictures are on page 47.

Chapter Name Change

Effective on July 1, 1960, the Southern California Chapter has been granted permission to change its chapter name to the "Greater Los Angeles Chapter." The action was initiated by the chapter's board of directors who felt that the new name would better define the geographical area covered by its 384 members.

Honorary Member

At the Council meeting during the recent AFCEA Convention, Herbert Clark Hoover, 31st President of the United States, was elected as an Honorary Member of the Association. Former President Hoover is being recognized for his outstanding work in fostering the advance of radio during his tenure as Secretary of Commerce in the 1920's. His name was placed in nomination by regional vice president Ray E. Myers.

Developmental Engineering Corporation

Developmental Engineering Corporation (DECO) of Washington, D. C., is a new group member. The company, which also has facilities at Leesburg, Virginia, and Boulder, Colorado, was prime contractor to the Navy for the Communication Moon Relay (CMR) system. The Association is indebted to Mr. Lester H. Carr, president of DECO, for arranging the CMR demonstration for the official opening of the 14th AFCEA Convention.

T. E. Harper, Operations Manager, will represent the company for association affairs. Others named to membership are: Ted L. Simpson, senior engineer; Lucien E. Rawls, assistant technical director; Arthur D. Watt, laboratory director; B. G. Hagaman, project manager; R. E. Ankers, Washington representative; R. L. Hensell, project manager; R. W. Moss, assistant project manager; L. G. Sturgill, senior engineer; Lynnwood L. Lay, senior engineer.

Sustaining Member

As we go to press, SIGNAL has learned that Western Electric Co., Inc. has transferred to a sustaining membership. The company list will appear in the August issue.

INDEX TO ADVERTISERS

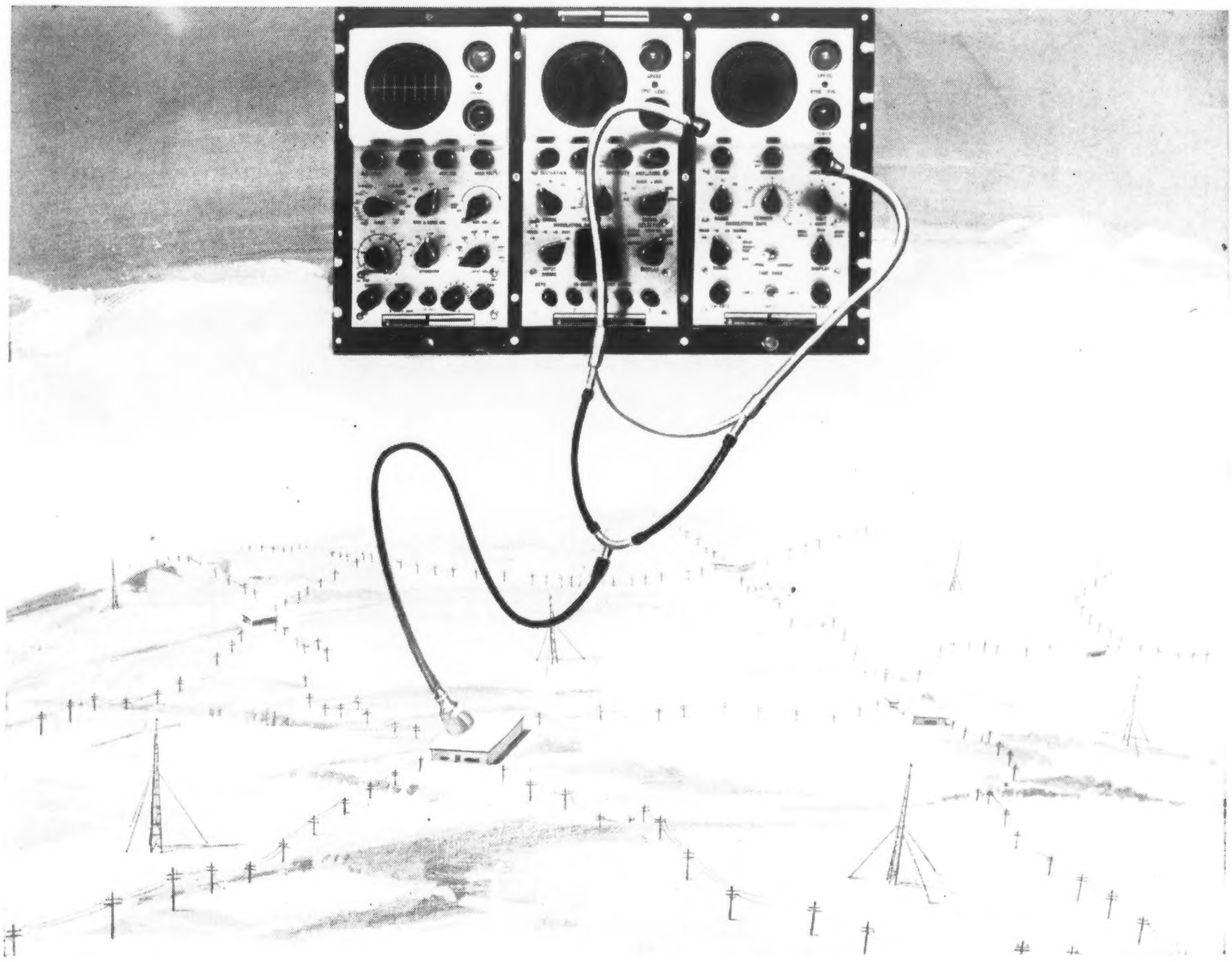
Director Retires

David R. Hull, a member of the board of directors of AFCEA, has retired from his position as vice president for defense, Raytheon Company. He was a member of the 1960 class of AFCEA board of directors and was elected to the 1964 class during the recent Convention.

Mr. Hull served two terms as president of Electronic Industries Association. He was a recipient of the 1960 EIA Medal of Honor, the first EIA president to receive such award while still in office.

After retiring from the Navy in 1948, as a Captain, he joined International Telephone and Telegraph Corp. as assistant technical director, and vice president and director of the Federal Telecommunications Laboratory. In 1950 he joined Raytheon Company as vice president and general manager of the Equipment Operations. In January, 1958, he was designated vice president for defense programs.

Mr. Hull is a director of Technical Operations, Inc., Applied Electronics Company, Raytheon Canada, Ltd., Mycalex Corporation of America and a member of the Board of American Standards Association.



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TELEMETRY TRANSMITTER—Model 3115 is a ruggedized 215-260 MC unit with extremely linear FM output under the most severe environmental conditions. With its record of outstanding performance in many missile programs, Model 3115 is specified by leading missile manufacturers.

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